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```
#find the quant. level by shifting by q, for the inverse it comes from the Huffman decoder#

LET
   lev_data = BARREL_SHIFT_RIGHT(q,lev_final),

#saturate the lev at 37, for the Huffman table,except in lpf_still mode, sond all the bits#
   lev_forw = CASE mode
        OF  lpf_still:lev_data
        ELSE   CASE lev_data GT_U b"00000100101"
          OF1:b"00000100101"
          ELSE lev_data
          ESAC
        ESAC,

    lev = MUX_2(STRING[input_exp+1]bit)(
                lev_forw,
                b"0" CONC lev_inv,
           dir_sel),
 #the level = 0 flag#
      lev_z = lev EQ_U ZERO(input_exp+1)b"0",

    inv_lev_z =  CASE lev_z
              OF t:b'0
                ELSE b'1
            ESAC,

  #the level value shifted up, and rounded#
       round_lev = BARREL_SHIFT_LEFT(q,lev) AND_B
            CASE mode
             OF  lpf_still:b"00" CONC ALL_SAME(input_exp-1)b"1"
             ELSE       BIT_STRING(input_exp+1)([input_exp+1]inv_lev_z) #if lev==0 out all 0's#
```

```
            ESAC,
#clear out extra bit for lpf_still case#


#calculate the proposed value:in the case n-o,round_lev is unsigned 10 bit, so result needs 11 bits#
#pro_no will always be in range as round_lev<|n-o|      #

    pro_no = ADD_SUB_ST(old,round_lev,CASE sgn_level
                    OFb'0:add,
                       b'1:subt
                    ESAC),

 #now pro_new = +/- round_lev#

     round_sel = CASE sgn_level
            OFb'0: left,
               b'1: right
            ESAC,

       pro_new = MUX_2{STRING[input_exp+1]bit}(
            round_lev ,
            (NEG_U round_lev)[2..input_exp+2],    #NEG sign extends#
          round_sel),

       out_sel = CASE difference
          OFdiff:left
          ELSE right
          ESAC.


   OUTPUT (MUX_2{STRING[input_exp]bit}(
```

```
            pro_no[3..input_exp+2],
            pro_new[2..input_exp+1],
            out_sel) ,
      lev[2..input_exp+1] ,
      sgn_level)


END.
#actel 1 bit full adder with active low cin and cout#
FN FA1B = (bit: ain bin cinb)    ->(bit,bit):#cob,s#
BEGIN
LET    a_c =B_TO_S ain CONC NOT_B(B_TO_S cinb) ,
       b_c = B_TO_S bin CONC NOT_B(B_TO_S cinb) ,
     out = ADD_U(a_c,b_c).
OUTPUT(CAST{bit} NOT_B(B_TO_S out[1]), out[2])
END.


#a Ripple carry adder using 1 bit full adder blocks#

#the actel version of the ADD BIOP's#

MAC ADD_S_ACTEL = (STRING[INT m]bit:ain,STRING[INT n]bit:bin,bit:cinb) ->STRING[IF m>=n THEN m+1 ELSE n+1 FI]bit:
BEGIN
     MAKE [IF m>=n THEN m ELSE n FI]FA1B:sum.

#signed nos so sign extend #
 LET a_c = IF m>=n THEN ain ELSE ALL_SAME{n-m}B_TO_S ain[1]  CONC ain FI,
       b_c = IF n>=m THEN bin ELSE ALL_SAME{m-n}B_TO_S bin[1] CONC bin  FI.
     LET subsignal = sum.
 #lsb#
```

```
JOIN   (a_c[IF m>=n THEN m ELSE n FI],b_c[IF m>=n THEN m ELSE n FI],cinb)   ->sum[IF m>=n THEN m ELSE n FI].

FOR INT j=1..(IF m>=n THEN m ELSE n FI) -1
JOIN (a_c[(IF m>=n THEN m ELSE n FI) -j],b_c[(IF m>=n THEN m ELSE n FI) -j],
     sum[(IF m>=n THEN m ELSE n FI) -j+1][1])            ->sum[(IF m>=n THEN m ELSE n FI) -j].

OUTPUT  CAST(STRING[IF m>=n THEN m+1 ELSE n+1 FI]bit)
(NOT_B( B_TO_S sum[1][1]) CONC
        CAST(STRING[IF m>=n THEN m ELSE n FI]bit)( [INT j=1..IF m>=n THEN m ELSE n FI] sum[j][2])
END.


MAC ADD_US_ACTEL = (STRING[INT m]bit:ain,STRING[INT n]bit:bin,bit:cinb) ->STRING[IF m>=n THEN m+1 ELSE n+1 FI]bit:
BEGIN
    MAKE [IF m>=n THEN m ELSE n FI]FA1B:sum.

#unsigned nos so extend by 0#
    LET a_c = IF m>=n THEN ain ELSE ZERO(n-m)b"0" CONC ain FI,
      b_c = IF n>=m THEN bin ELSE  ZERO(m-n)b"0" CONC bin FI.
    LET subsignal = sum.

#lsb#
JOIN   (a_c[IF m>=n THEN m ELSE n FI],b_c[IF m>=n THEN m ELSE n FI],cinb)   ->sum[IF m>=n THEN m ELSE n FI].

FOR INT j=1..(IF m>=n THEN m ELSE n FI) -1
JOIN (a_c[(IF m>=n THEN m ELSE n FI) -j],b_c[(IF m>=n THEN m ELSE n FI) -j],
     sum[(IF m>=n THEN m ELSE n FI) -j+1][1])            ->sum[(IF m>=n THEN m ELSE n FI) -j].

OUTPUT  CAST(STRING[IF m>=n THEN m+1 ELSE n+1 FI]bit)
(NOT_B(B_TO_S sum[1][1]) CONC
        CAST(STRING[IF m>=n THEN m ELSE n FI]bit)([INT j=1..IF m>=n THEN m ELSE n FI] sum[j][2]) )
```

```
END.

MAC ADD_SUB_ST =(STRING[INT m]bit:ain,STRING[INT n]bit:bin,t_add:sel) ->STRING[IF m>=n THEN m+1 ELSE n+1 FI]bit:

BEGIN

#sign extend inputs#
     LET a_s = CAST(STRING[1]bit)ain[1] CONC ain,
       b_s = CAST(STRING[1]bit)bin[1] CONC bin,
       sel_bit = CAST(STRING[1]bit)sel,
 #ACTEL#
      bin_inv = XOR_B(n+1)(b_s, ALL_SAME(n+1)sel_bit),

 #cinb is active low so cast sel(add->0,sub->1) & invert it#
        out=  ADD_S_ACTEL(a_s,bin_inv,CAST(bit)NOT_B sel_bit),
      binout= out[2..IF m>=n THEN m+2 ELSE n+2 FI]

 OUTPUT binout
 END.

  #transformation ops#
  MAC B_TO_S= (bit:in)   ->STRING[1]bit: CASE in
                         OF b'0:b"0",
                           b'1:b"1"
                    ESAC.
  MAC I_TO_SC(INT n) = (t_result: in)    -> (flag,STRING[n]bit): BIOP TRANSFORM_S.
  MAC SC_TO_I(INT n) = (STRING[n]bit:in)  -> (flag,t_result): BIOP TRANSFORM_S.

  MAC S_TO_IN = (STRING[INT n]bit:in) -> (flag,t_input): BIOP TRANSFORM_S.
  MAC IN_TO_S(INT n) = (t_input: in)    -> (flag,STRING[n]bit): BIOP TRANSFORM_S.
```

```
MAC U_TO_IN = (STRING[INT n]bit:in) -> (flag,t_input): BIOP TRANSFORM_US.

MAC U_TO_LEN = (STRING[INT n]bit:in) -> (flag,t_length): BIOP TRANSFORM_US.
MAC LEN_TO_U[INT n] =(t_length:in)  -> (flag,STRING[n]bit): BIOP TRANSFORM_US.

MAC Q_TO_U[INT n] =(t_quant:in)     -> (flag,STRING[n]bit): BIOP TRANSFORM_US.
MAC S_TO_C  = (STRING[INT n]bit:in)    ->(flag,t_col):BIOP TRANSFORM_US.
MAC S_TO_R  = (STRING[INT n]bit:in)    ->(flag,t_row):BIOP TRANSFORM_US.
MAC S_TO_B  = (STRING[INT n]bit:in)    ->(flag,t_blk):BIOP TRANSFORM_US.
MAC S_TO_SUB  = (STRING[INT n]bit:in)    ->(flag,t_sub):BIOP TRANSFORM_US.
MAC S_TO_SPARC  = (STRING[INT n]bit:in)    ->(flag,t_sparc_addr):BIOP TRANSFORM_US.

MAC C_TO_S[INT n] = (t_col: in)    -> (flag,STRING[n]bit): BIOP TRANSFORM_US.
MAC R_TO_S[INT n] = (t_row: in)    -> (flag,STRING[n]bit): BIOP TRANSFORM_US.

MAC I_TO_Q = (t_input:in)    ->t_quant:ARITH in.


MAC B_TO_I= (bit:in)   ->t_result: CASE in
                       OF b'0:result/0,
                        b'1:result/1
                  ESAC.

MAC CARRY= (t_add:in)  ->STRING[1]bit: CASE in
                       OF add:b"0",
                        subt:b"1"
                  ESAC.
MAC BOOL_BIT = (bool:in)       ->STRING[1] bit:
CASE in
OF  t:b"1"
```

```
ELSE b"0"
ESAC.

MAC BOOL_STRING(INT n) = ([n]bool:in)  ->STRING[n] bit:
(LET out = BOOL_BIT in[1].
OUTPUT IF n=1
     THEN out
     ELSE out[1] CONC  BOOL_STRING(n-1)(in[2..n])
     FI
).

MAC BIT_STRING(INT n) = ([n]bit:in)  ->STRING[n] bit:
(LET out = B_TO_S in[1].
OUTPUT IF n=1
     THEN out
     ELSE out[1] CONC  BIT_STRING(n-1)(in[2..n])
     FI
).

MAC ZERO(INT n) = (STRING[1]bit:dummy)  ->STRING[n]bit:
IF n=1 THEN b"0"
ELSE b"0" CONC ZERO(n-1) b"0"
FI.

MAC ALL_SAME(INT n) = (STRING[1]bit:dummy)  ->STRING[n]bit:
IF n=1 THEN dummy
ELSE dummy CONC ALL_SAME(n-1) dummy
FI.
```

COM
The operators described in this section are optimal and take two-valued operands and produce a two-valued result. They may not be used with ELLA-integers or associated types.

The first basic value of any two-valued type declaration of the operand(s) and the result are interpreted by the operations as false, and the second basic value is interpreted as true. Thus, given the following type declarations:

MOC

MAC AND_T = (TYPE t: a b) -> t: BIOP AND.

MAC OR_T = (TYPE t: a b) -> t: BIOP OR.

MAC XOR_T = (TYPE t: a b) -> t: BIOP XOR.

MAC NOT_T = (TYPE t: a) -> t: BIOP NOT.

COM
The following operations take bit-string operand(s) and are bitwise, ie the operation is performed on the operand(s) one bit at a time. The operand(s) and result must all be ELLA-strings of the same length.
MOC

MAC AND_B = (STRING[INT n]bit,STRING(n)bit) -> STRING[n]bit:
BIOP AND.

MAC OR_B = (STRING[INT n]bit,STRING(n)bit) -> STRING[n]bit:
BIOP OR.

```
MAC XOR_B = (STRING[INT n]bit,STRING[n]bit) -> STRING[n]bit:
BIOP XOR.

MAC NOT_B = (STRING[INT n]bit) -> STRING[n]bit:
BIOP NOT.
```

COM
The operators described in this section may be used with primitive types ie all enumerated types, except associated types, rows, strings and structures. These operations take two operands which must be of the same type and the result can be any two-valued type; we have packaged these BIOPs so they output a value of type 'bool' - you may change this if you wish.
MOC

```
MAC EQ = (TYPE t: a b ) -> bool: BIOP EQ.

MAC GT = (TYPE t: a b ) -> bool: BIOP GT.

MAC GE = (TYPE t: a b ) -> bool: BIOP GE.

MAC LT = (TYPE t: a b ) -> bool: BIOP LT.

MAC LE = (TYPE t: a b ) -> bool: BIOP LE.
```

COM
NOTE: these BIOPs are designed to take any primitive ELLA type. Since it is not possible to distinguish between primitive and other types, whilst leaving the macro declaration general enough to allow the use of all two-valued types that might be declared, there are type-checking limitations. This is done at network assembly, so use of illegal types will not generate an error

message until then.

NB: ARITH provides for relational operations on ELLA-integer types.
MOC

COM
These operations are optimal in their handling of '?' and operate on bit-string representations of unsigned integers. The result may be any two-valued type; we have used type 'bool'. The inputs can be of different lengths and different types.
MOC

MAC EQ_U = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP EQ_US.

MAC GT_U = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP GT_US.

MAC GE_U = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP GE_US.

MAC LT_U = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP LT_US.

MAC LE_U = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP LE_US.

Bit-strings representing signed numbers
COM
These operations are optimal and operate on bit-string representations of signed integers. The result may be any two-valued type; we have used type

'bool'. The inputs can be of different lengths and different types.
MOC

MAC EQ_S = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP EQ_S.

MAC GT_S = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP GT_S.

MAC GE_S = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP GE_S.

MAC LT_S = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP LT_S.

MAC LE_S = (STRING[INT n]bit,STRING[INT m]bit) -> bool:
BIOP LE_S.

Shift operations
COM
These operate on bit-strings. Both the enclosing macro and the BIOP are parameterised by the number of bits to be shifted (INT p). The macro and BIOP parameters must match. Note that no bits are lost in these shift operations, so you may need to trim the result to achieve the desired effect.

SR means shift right; SL means shift left.

The macros with the suffix '_S' perform arithmetic shifts; those with the

suffix '_U' perform bool shifts.
MOC

MAC SL_S(INT p) = (STRING[INT n]bit) -> STRING[n + p]bit:
BIOP SL(p).

MAC SL_U(INT p) = (STRING[INT n]bit) -> STRING[n + p]bit:
BIOP SL(p).

MAC SR_S(INT p) = (STRING[INT n]bit) -> STRING[n + p]bit:
BIOP SR_S(p).

MAC SR_U(INT p) = (STRING[INT n]bit) -> STRING[n + p]bit:
BIOP SR_US(p).

Arithmetic operations

Bit-strings representing unsigned numbers

addition.

MAC ADD_U = (STRING[INT m]bit,STRING[INT n]bit)
-> STRING[IF m >= n THEN m+1 ELSE n+1 FI]bit:
BIOP PLUS_US.

subtraction on bit-string representations of unsigned integers. Output is
signed.

MAC SUB_U = (STRING[INT m]bit,STRING[INT n]bit)
-> STRING[IF m >= n THEN m+1 ELSE n+1 FI]bit:

```
BIOP MINUS_US.

# negation.  Output is signed. #

MAC NEG_U = (STRING[INT n]bit) -> STRING[n+1]bit:
BIOP NEGATE_US.

# multiplication. #

MAC MULT_U = (STRING[INT m]bit,STRING[INT n]bit) -> STRING[m+n]bit:
BIOP TIMES_US.

COM
- divide.  If the divisor is non-zero then the first element of the output is
'ok' and the second and third elements are the quotient and remainder;
otherwise, the first element is 'error' and the rest is set to '?'.
MOC

MAC DIV_U = (STRING[INT m]bit,STRING[INT n]bit)
                -> (flag,STRING[m]bit,STRING[n]bit):
BIOP DIVIDE_US.

# square root. #


MAC SQRT_U = (STRING[INT n]bit) -> STRING[(n+1) % 2]bit:
BIOP SQRT_US.
COM
 modulus (result always positive).  If the divisor is non-zero, then the first
 element of the output is 'ok' and the second element is the modulus;
 otherwise, the first element is 'error'  and the second is '?'.
```

```
MOC

MAC MOD_U = (STRING[INT m]bit,STRING[INT n]bit)
            -> (flag,STRING[n]bit):
BIOP MOD_US.

COM
- convert between one range of bit-string and another.  If the input value
cannot be represented as a legal value for the output  string, the  result is
'error' and '?'.
MOC

MAC RANGE_U {INT m} = (STRING[INT n]bit)
                -> (flag,STRING[m]bit):
BIOP RANGE_US.

# Bit-strings representing signed numbers #

# addition. #

MAC ADD_S = (STRING[INT m]bit,STRING[INT n]bit)
            -> STRING[IF m >= n THEN m+1 ELSE n+1 FI]bit:
BIOP PLUS_S.

#  subtraction. #

MAC SUB_S = (STRING[INT m]bit,STRING[INT n]bit)
            -> STRING[IF m >= n THEN m+1 ELSE n+1 FI]bit:
BIOP MINUS_S.

# negation. #
```

```
MAC NEG_S = (STRING[INT n]bit) -> STRING[n+1]bit:
BIOP NEGATE_S.

# multiplication. #

MAC MULT_S = (STRING[INT m]bit,STRING[INT n]bit) -> STRING[m+n]bit:
BIOP TIMES_S.

COM
divide.  If the divisor is non-zero then the first element of the output is
'ok 'and the second and third elements are the quotient and remainder;
otherwise, the first element is 'error' and the rest is set to '?'.  The
remainder has the same sign as the divisor.
MOC

MAC DIV_S = (STRING[INT m]bit,STRING[INT n]bit)
            -> (flag,STRING[m]bit,STRING[n]bit):
BIOP DIVIDE_S.

COM
modulus (result always positive).  If the divisor is non-zero, then the first
element of the output is 'ok' and the second element is the unsigned modulus;
otherwise, the first element is 'error' and the second is '?'.
MOC

MAC MOD_S = (STRING[INT m]bit,STRING[INT n]bit)
            -> (flag,STRING[n]bit):
BIOP MOD_S.

COM
```

- convert between one range of bit-string and another. If the input value cannot be represented as a legal value for the output string, the result is 'error' and '?'.
MOC

```
MAC RANGE_S {INT m}= (STRING[INT n]bit)
                -> (flag,STRING[m]bit):
BIOP RANGE_S.

# absolute value. The output represents an unsigned integer. #

MAC ABS_S = (STRING[INT n]bit) -> STRING[n]bit:
BIOP ABS_S.


# Built in Register #

MAC DREG{INT interval delay} = (TYPE t) -> t:
ALIEN REGISTER {interval, ?t, 0, delay}.

MAC GEN_DREG{INT interval, CONST (TYPE t): init, INT skew delay} = (t) -> t:
ALIEN REGISTER {interval, init, skew, delay}.


# Built in type conversion #

MAC CAST{TYPE t} = (TYPE s) -> t:
ALIEN CAST.
```

```
MAC ALL_SAME(INT n) = (STRING[1]bit:dummy)  ->STRING[n]bit:
BEGIN
FAULT IF n < 1 THEN "N<1 in ALL_SAME" FI.
OUTPUT IF n=1 THEN dummy
ELSE dummy CONC ALL_SAME(n-1) dummy
FI
END.

MAC CAST (TYPE to) = (TYPE from:in)    ->to:ALIEN CAST.

MAC ZERO(INT n) = (STRING[1]bit:dummy)  ->STRING[n]bit:
BEGIN
FAULT IF n < 1 THEN "N<1 in ZERO" FI.
OUTPUT IF n=1 THEN b"0"
    ELSE b"0" CONC ZERO(n-1) b"0"
    FI
END.

MAC B_TO_S= (bit:in)   ->STRING[1]bit: CASE in
                       OF b'0:b"0",
                          b'1:b"1"
                  ESAC.

MAC S_TO_IN = (STRING[input_exp]bit:in)    -> (flag,t_input): BIOP TRANSFORM_S.
MAC IN_TO_S(INT n) = (t_input: in) -> (flag,STRING[n]bit): BIOP TRANSFORM_S.

MAC S_HUFF = (STRING[6]bit)    ->(flag,t_huffman):BIOP TRANSFORM_US.
MAC HUFF_S = (t_huffman)           ->(flag,STRING[6]bit):BIOP TRANSFORM_US.


MAC BOOL_BIT = (bool:in)   ->STRING[1] bit:
```

```
CASE in
OF  t:b"1"
ELSE b"0"
ESAC.
MAC BIT_BOOL= (bit:in)      ->bool:
CASE in
OF  b'1:t
ELSE f
ESAC.


MAC BOOL_STRING(INT n) = ([n]bool:in) ->STRING[n] bit:
(LET out = BOOL_BIT in[1].
OUTPUT IF n=1
   THEN out
   ELSE out[1] CONC  BOOL_STRING(n-1)(in[2..n])
   FI
).
# defines the types used for the 2D wavelet chip#

#constant values#
INT    result_exp=14,      #length of result arith#
   input_exp=10,       #length of 1D convolver input/output#
   qmax = 7,         #maximum shift value for quantisation constant#
   result_range = 1 SL (result_exp-1),
   input_range = 1 SL (input_exp-1),
   max_octave=3, #no of octaves=max_octave +1, can not be less in this example#
   no_octave=max_octave+1,   #"#
   xsize = 10,   #no of bits for ximage#
   ysize = 9,#no of bits for yimage#
   ximage=319,#the xdimension -1 of the image, ie no of cols#
```

```
    yimage=239 #the ydimension -1 of the image, ie no of rows#


#int types#
TYPE t_result= NEW result/( -(result_range)..(result_range-1)),
    t_input= NEW input/( -(input_range)..(input_range-1)),
    t_length= NEW len/(0..15),
    t_inp  = NEW inp/(0..1023),
    t_blk  =NEW blk/(0..3),
    t_sub  =NEW sub/(0..3),
    t_col  =NEW col/(0..ximage),
    t_row  =NEW row/(0..yimage),
    t_carry    =NEW carry/(0..1),
    t_quant    =NEW quant/(0..qmax),
 #address for result&dwt memory, ie 1 frame#
    t_sparc_addr  =NEW addr/(0..(1 SL max_octave)*( (ximage+1)*(yimage+1)+(ximage+1))-1 ),
    t_octave=NEW oct/(0..(max_octave+1)),

  #bit string and boolean types types#
     bit = NEW b('0' | '1'),
     bool = NEW (f|t),
     flag = NEW(error | ok),

  #control signals#
     t_reset = NEW(rst|no_rst),
     t_load  = NEW(write|read),   #r/wbar  control#
     t_cs =  NEW(no_select|select),  #chip select control#
     t_updown= NEW(down|up),       #up/down counter control#
     t_diff=  NEW(diff|nodiff),  #diff or not in quantiser#
     t_intra = NEW(intra|inter),
```

```
#convolver mux & and types#
   t_mux = NEW(left|right),
   t_mux3 = NEW(l|c|r),
   t_mux4 = NEW(uno|dos|tres|quatro),
   t_add = NEW(add|subt),
   t_direction=NEW(forward|inverse),

#counter types#
    t_count_control=NEW(count_rst|count_carry),
    t_count_2 = NEW(one|two),
#state types#
    t_token = NEW (t_0|t_1|t_11|t_100|t_101),
    t_mode= NEW(void|void_still|stop|send|still|still_send|pf_send|pf_still|pf_stop),
    t_cycle = NEW(token_cycle|data_cycle|skip_cycle),
    t_state= NEW(start|up0|up1|zz0|zz1|zz2|zz3|down1),
    t_decode = NEW(load_low|load_high),
    t_high_low = NEW(low|high),
    t_huffman  = NEW(pass|huffman),
    t_fifo = NEW(ok_fifo|error_fifo),
#types for the octave control unit#
    t_channel= NEW(y|u|v),
    t_channel_factor= NEW(luminance|color),
#types for the control of memory ports#
    t_sparcport=(t_sparc_addr#wr_addr#,t_sparc_addr#rd_addr#,t_load#w/r#,t_cs#cs#)

#generate random values for test memories#

FN GEN_RANDOM_MEM = (bool:ck,t_reset:reset)  ->t_input: BOOL_INT10 PRBS11(ck,reset).
TYPE t_test = NEW(no|yes).
#.....#
#These functions change types from boolean to inputeger and vice- #
```

```
#versa. Supports 1 & 8 bit booleans.                    #
#.....#

FN INT_BOOL1=(t_input:k)   ->bool:        # 1bit input to binary #
       CASE    k
       OFinput/0:f,
          input/1:t
   ESAC.

FN BOOL_INT=(bool:b)   ->t_input:     # 1 bit bool to input #
       CASE    b
       OF f:input/0,
          t:input/1
   ESAC.

FN * =(t_input:a b)  ->t_input: ARITH a*b.
FN % =(t_input:a b)->t_input: ARITH a%b.
FN - =(t_input:a b)  ->t_input: ARITH a-b.
FN + =(t_input:a b) ->t_input: ARITH a+b.
FN = =(t_input:a b)  ->t_test: ARITH IF a=b THEN 2 ELSE 1 FI.

COM
FN CHANGE_SIGN = (t_input:i) ->t_input: #changes sign for 8-bit 2's#
   ARITH  IF i<0 THEN 128+i        #complement no,  #
          ELSE i
          FI.

FN SIGN = (t_input:i)   ->bool:         #gets sign for 2's#
   ARITH  IF i<0 THEN 1          #complement nos  #
          ELSE 2
```

```
        FI.

FN TEST_SIZE = (t_input:x)  ->bool:
#tests to see if the input is bigger than an 8-bit inputeger#
   ARITH IF ( (x<=-128) AND (x>127)) THEN 1
                ELSE 2     FI.


FN INT8_BOOL=(t_input:orig)    ->[8]bool:
BEGIN

    SEQ
       VAR i1:=input/0,    #input variables#
          i0:=CHANGE_SIGN(orig),
          b:=(f,f,f,f,f,f,f,f,SIGN(orig));
     [INT n=1..7]  (
           i1:=i0%input/2;
           b[n]:=INT_BOOL1(i0-input/2*1);
           i0:=i1
           );
      OUTPUT CASE TEST_SIZE orig        #checks to see if orig will#
         OF1:  [8]?bool,  #fit inputo an 8_bit value#
            f:  b
         ESAC
    END.

    FN BOOL_INT8=([8]bool:b)   ->t_input: #converts 8bit boolean to 2's#
    BEGIN
       SEQ              #complement inputeger   #
          VAR  sum:=input/-128 * BOOL_INT(b[8]),
             exp:=input/1;
```

```
    [INT k=1..7]
       (  sum:=sum+exp*BOOL_INT(b[k]);
          exp:=input/2 * exp
       );
  OUTPUT sum
END.


MOC
FN BOOL_INT10=([10]bool:b)    ->t_input: #converts 10bit boolean to 2's#
BEGIN
   SEQ              #complement integer  #
      VAR  sum:=input/-512 * BOOL_INT(b[10]),
           exp:=input/1;
      [INT k=1..9]
         (  sum:=sum+exp*BOOL_INT(b[k]);
            exp:=input/2 * exp
         );
    OUTPUT sum
  END.
  COM
  FN BOOL_INT16 =([8]bool:in1 in2)  ->t_input:
  # convetrs a 16-bit no., (lsbs,msbs) inputo inputeger form)#
  (BOOL_INT8(in1))+((input/256)*BOOL_INT8(in2))+((input/256)*BOOL_INT(in1[8])).
                          #hack because of sign extend#
                             #of lsb #

  MOC
  COM
  FN PRBS10 = (t_reset:reset) ->[10]bool:
  #A 10 bit prbs generator,feedback taps on regs 3 & 10.#
  BEGIN
```

```
  MAKE[10]MYLATCH:l,
     XNOR:xnor.

  FOR INT k=1..9 JOIN
     (reset,l[k])    ->l[k+1].

  JOIN  (reset,xnor)  ->l[1],
     (l[10],l[3]) ->xnor.

  OUTPUT l
END.
MOC
FN PRBS11 = (bool:ck,l_reset:reset)    ->[10]bool:
#A 11 bit prbs generator,feedback taps on regs 2 & 11.#
BEGIN
   MAKE[11]DFF(bool):l,
      XOR:xor.

   FOR INT k=1..10   JOIN
      (ck,reset,l[k],f)   ->l[k+1].

   JOIN  (ck,reset,NOTxor,f) ->l[1],
      (l[11],l[2]) ->xor.

   OUTPUT l[1..10]
END.
COM
FN PRBS16 = (bool:reset)->[16]bool:
#A 16 bit prbs generator,feedback taps on regs 1,3,12,16#
BEGIN
   MAKE[16]MYLATCH:l,
```

```
    XOR_4:xor,
    NOT:xnor.

  FOR INT k=1..15   JOIN
    (ck,reset,I[k])->I[k+1].

  JOIN  (ck,reset,xnor)  ->I[1],
    (I[1],I[3],I[16],I[12])  ->xor,
    xor    ->xnor.
  OUTPUT ([INT k=1..16]I[k])
END.
FN PRBS12 = (clock:ck,bool:reset)  ->[12]bool:
#A 12 bit prbs generator,feedback taps on regs 1,4,6,12.#
BEGIN
  MAKE[12]MYLATCH:I,
    XOR_4:xor,
    NOT:xnor.

  FOR INT k=1..11   JOIN
    (ck,reset,I[k])->I[k+1].

  JOIN  (ck,reset,xnor)  ->I[1],
    (I[1],I[4],I[6],I[12])   ->xor,
    xor    ->xnor.
  OUTPUT ([INT k=1..12]I[k])
END.

FN PRBS8 = (clock:ck,bool:reset)   ->[8]bool:
#A 8 bit prbs generator,feedback taps on regs 2,3,4,8.#
BEGIN
  MAKE[8]MYLATCH:I,
```

```
    XOR_4:xor,
    NOT:xnor.

  FOR INT k=1..7 JOIN
    (ck,reset,I[k])->I[k+1].

  JOIN  (ck,reset,xnor)  ->I[1],
    (I[2],I[3],I[4],I[8])  ->xor,
    xor    ->xnor.
  OUTPUT ([INT k=1..8]I[k])
  END.
MOC
#test for palmas chip#
TYPE t_int32 = NEW int32/(-2147483000..2147483000).

FN RMS = (bool:ck,t_reset:reset,t_cycle:cycle, t_input:old new)    ->t_int32:
BEGIN

FN I_32 = (t_input:in)  ->t_int32:ARITH in.
FN DV = (t_int32:a b)  ->t_int32:ARITH a%b.
FN PL = (t_int32:a b)  ->t_int32:ARITH a+b.
FN MI = (t_int32:a b)  ->t_int32:ARITH a-b.
FN TI = (t_int32:a b)  ->t_int32:ARITH a*b.

MAKEDFF_INIT(t_int32):old_error.

LET  err = I_32old MI I_32new,
   err2 = (errTIerr) PL old_error.

JOIN  (ck,reset,CASE cycle
       OFdata_cycle:write
```

```
      ELSE read
      ESAC,err2,int32/0)     ->old_error.

OUTPUT old_error
END.

FN EQ = (t_input:a b)  ->bool:ARITH IF a=b THEN 2
                ELSE 1
                FI.

FN SPARC_MEM = (t_input:in,t_sparc_addr:wr_addr,t_sparc_addr:rd_addr,t_load:rw_sparc#,t_cs:cs#)->t_input:
        RAM(input/0).

FN FIFO     =(bool:ck,t_reset:reset,STRING[16]bit:buffer_in,t_direction:direction,t_load:fifo_read fifo_write)
                    ->(STRING[16]bit,[2]t_fifo):    #fifo_full,empty#
BEGIN
      FN  FIFO_RAM = (STRING[16]bit:in,t_inp:wr_addr rd_addr,t_load:rw_fifo)   ->STRING[16]bit:
      RAM(b"0000000000000000").

      FN FULL = (t_inp:in)   ->t_fifo:ARITH IF in>1023 THEN 2   #fifo full#
                      ELSE 1
                      FI.
      FN INCR = (t_inp:in)   ->t_inp:ARITH in+1.

         FN EMPTY = (t_inp:in)   ->t_fifo:ARITH IF in<0 THEN 2  #fifo empty#
                                 ELSE  1
                                 FI.
         FN DECR = (t_inp:in)   ->t_inp:ARITH in-1.


MAKE DFF{t_inp}:address,
```

```
   FIFO_RAM:ram.

LET   next =    CASE direction
      OFforward: CASE fifo_write
            OFwrite:INCR address
            ELSE address
            ESAC,
         inverse:CASE fifo_read
            OFread:INCR address
            ELSE   address
                  ESAC
      ESAC.



JOIN  (ck,reset,next,inp/0)        ->address,
   (buffer_in ,address,address,CASE direction
               OF  inverse:read,
                 forward:fifo_write
               ESAC) ->ram.

OUTPUT     (ram,(FULL address,EMPTY address))
END.

FN TEST_PALMAS = (bool:ck,t_reset:reset,t_direction:direction,t_intra:intra_inter,t_channel_factor:channel_factor,
      t_input:q_int,t_quant:quant_norm,t_result:threshold comparison)

      ->(STRING[16]bit,#buffer_out#[2]t_load#fifo_read fifo_write#,bool,bool,t_int32):


BEGIN
```

```
    MAKE SPARC_MEM:new old_inv old_forw,
        FIFO:fifo,
        PALMAS:palmas_inv palmas_forw.

LET     col_length = (IN_TO_S{9} input/31)[2],

        row_length= (IN_TO_S{9} input/31)[2],

        ximage_string = (IN_TO_S{9} input/32)[2],

        yimage_string = (IN_TO_S{9} input/32)[2],

        yimage_string_3 = (IN_TO_S{9} input/80)[2],

        pro_forw = palmas_forw[1],

        pro_inv = palmas_inv[1],

        forw_frame_done = palmas_forw[7],

        inv_frame_done = palmas_inv[7],

        cycle = palmas_inv[8],

        old_equal = CASE cycle
                    OF  data_cycle:old_forw EQ  palmas_inv[1]
                    ELSE t
                    ESAC.

JOIN
```

```
#fix fifo full/empty logic later#
(ck,reset,forward,intra_inter,channel_factor,q_int,quant_norm,b"0000000000000000",new,old_forw, threshold,comparison,
#fifo[2][1],fifo[2][2]#ok_fifo,ok_fifo, col_length,row_length,ximage_string,yimage_string, yimage_string_3)
                        ->palmas_forw,

(ck,reset,inverse,intra_inter,channel_factor,q_int,quant_norm,fifo[1],new,old_inv, threshold,comparison,
#fifo[2][1],fifo[2][2]#ok_fifo,ok_fifo, col_length,row_length,ximage_string,yimage_string, yimage_string_3)
                         ->palmas_inv,

#old forward mem, on forward use as normal, on inverse read values to compare with inverse#
(pro_forw,CASE direction
    OF   forward:palmas_forw[2],
      inverse:palmas_inv[2]
   ESAC, CASE direction
      OF   forward:palmas_forw[2],
         inverse:palmas_inv[2]
      ESAC,CASE direction
         OF   forward:palmas_forw[4][1],
            inverse:read
         ESAC)          ->old_forw,

(palmas_inv[1],palmas_inv[2],palmas_inv[2],CASE direction
                  OF  forward:read,
                    inverse:palmas_inv[4][1]
                  ESAC)     ->old_inv,

#(input/0,palmas_forw[2],palmas_forw[2],palmas_forw[3][1])       ->new,#
(input/0,CASE direction
      OF   forward:palmas_forw[2],
         inverse:palmas_inv[2]
      ESAC, CASE direction
```

```
        OF   forward:palmas_forw[2],
             inverse:palmas_inv[2]
        ESAC,CASE direction
             OF   forward:palmas_forw[3][1],
                  inverse:read
             ESAC)                          ->new,


(ck,reset,CASE direction
     OF    inverse:b"0000000000000000",
           forward:palmas_forw[5]
   ESAC          ,direction,palmas_inv[6][1],palmas_forw[6][2])      ->fifo.

OUTPUT (palmas_forw[5],palmas_forw[6],palmas_forw[7],old_equal,RMS(ck,reset,cycle,old_inv,new) )
END.

#test for palmas chip#
TYPE t_int32 = NEW int32/(-2147483000..2147483000).

FN RMS = (bool:ck,t_reset:reset,t_cycle:cycle, t_input:old new) ->t_int32:
BEGIN

FN I_32 = (t_input:in)  ->t_int32:ARITH in.
FN DV = (t_int32:a b)   ->t_int32:ARITH a%b.
FN PL = (t_int32:a b)   ->t_int32:ARITH a+b.
FN MI = (t_int32:a b)   ->t_int32:ARITH a-b.
FN TI = (t_int32:a b)   ->t_int32:ARITH a*b.

MAKE   DFF_INIT(t_int32):old_error.
LET  err = I_32old MI I_32new,
   err2 = (errTIerr) PL  old_error.
```

```
JOIN   (ck,reset,CASE cycle
          OF    data_cycle:write
          ELSE  read
          ESAC,err2,Int32/0)          ->old_error.

OUTPUT old_error
END.
FN EQ = (t_input:a b)  ->bool:ARITH IF a=b THEN 2
                       ELSE 1
                       FI.

FN SPARC_MEM = (t_input:in,t_sparc_addr:wr_addr,t_sparc_addr:rd_addr,t_load:rw_sparc#,t_cs:cs#)->t_input:
          RAM(input/0).

FN FIFO_BIG       =(bool:ck,t_reset:reset,STRING[16]bit:buffer_in,t_direction:direction,t_load:fifo_read fifo_write)
                          ->(STRING[16]bit,[2]t_fifo):   #fifo_full,empty#
BEGIN
          FN  FIFO_RAM = (STRING[16]bit:in,t_sparc_addr:wr_addr rd_addr,t_load:rw_fifo)  ->STRING[16]bit:
          RAM(b"0000000000000000").

          FN FULL = (t_sparc_addr:in)    ->t_fifo:ARITH IF in>1023 THEN 2      #fifo full#
                                 ELSE  1
                                 FI.
          FN INCR = (t_sparc_addr:in)    ->t_sparc_addr:ARITH in+1.

          FN EMPTY = (t_sparc_addr:in)   ->t_fifo:ARITH IF in<0 THEN 2  #fifo empty#
                                 ELSE  1
                                 FI.
          FN DECR = (t_sparc_addr:in)    ->t_sparc_addr:ARITH in-1.
```

```
MAKE   DFF{t_sparc_addr}:address,
     FIFO_RAM:ram.
LET    next = CASE direction
         OF    forward: CASE fifo_write
                  OF    write:INCR address
                  ELSE  address
                  ESAC,
               inverse:CASE fifo_read
                  OF    read:INCR address
                  ELSE  address
                  ESAC
         ESAC.



JOIN   (clk,reset,next,addr/0)        ->address,
     (buffer_in ,address,address,CASE direction
                  OF  inverse:read,
                     forward:fifo_write
                  ESAC)     ->ram.

OUTPUT       (ram,(FULL address,EMPTY address))
END.

FN TEST_PALMAS = (bool:clk,t_reset:reset, bool:load_memory,t_direction:direction,t_intra:intra_inter,
       t_channel_factor:channel_factor,[4]t_quant:quant_norm,[4]t_result:threshold,
       t_input: col_length_in row_length_in ximage_string_in yimage_string_in,
       t_result:yimage_string_3_in)

       ->(bool#,t_int32#):
```

```
BEGIN

    FN NEW_ADDRESS = (t_sparc_addr:in)          ->t_sparc_addr: ARITH ((in +1) MOD 120000).

   MAKE SPARC_MEM:new old_inv old_forw,
      FIFO_BIG:fifo,
      PRBS11:prbs,
         DFF{t_sparc_addr}:address,
      PALMAS:palmas.

LET         col_length = (IN_TO_S{10} col_length_in)[2],

            row_length= (IN_TO_S{9} row_length_in)[2],

            ximage_string = (IN_TO_S{10} ximage_string_in)[2],

            yimage_string = (IN_TO_S{9} yimage_string_in)[2],

            yimage_string_3 = (I_TO_SC{11} yimage_string_3_in)[2],

          pro= palmas[1],

          random_data = BOOL_INT10 prbs,

          frame_done = palmas[7],

          cycle = palmas[8],

          old_equal = CASE cycle
```

```
                OF  data_cycle:old_forw EQ  palmas[1]
                ELSE t
                ESAC.


JOIN
#fix fifo full/empty logic later#
(ck,reset,direction,intra_inter,channel_factor,quant_norm,CASE direction
                        OFforward:b"0000000000000000"
                        ELSE fifo[1]
                        ESAC,new,CASE direction
                              OF forward:old_forw
                              ELSE old_inv
                              ESAC, threshold,
#fifo[2][1],fifo[2][2]#ok_fifo,ok_fifo, col_length,row_length,ximage_string,yimage_string, yimage_string_3)
                     ->palmas,
(ck,reset,(NEW_ADDRESS address) ,addr/0)                    -> address,

(ck,reset)                                  ->prbs,

#old forward mem, on forward use as normal, on inverse read values to compare with inverse#
(CASE load_memory
OF    t:DFF(t_input)(ck,reset,random_data,input/0)
ELSE   palmas[1]
ESAC   , CASE load_memory
       OF    t:address
       ELSE      palmas[2]
       ESAC,           palmas[2], CASE load_memory
                          OF  t:write
                          ELSE      CASE direction
                                 OF   forward:palmas[4][1],
```

```
                        inverse:read
                    ESAC
                ESAC)           ->old_forw,

(CASE load_memory
OF   t:DFF(t_input)(ck,reset,random_data,input/0)
ELSE  palmas[1]
ESAC  , CASE load_memory
      OF   t:address
      ELSE     palmas[2]
      ESAC,          palmas[2], CASE load_memory
                        OF  t:write
                        ELSE     CASE direction
                                 OF   forward:read,
                                      inverse:palmas[4][1]
                                 ESAC
                        ESAC)           ->old_inv,

(CASE load_memory
OF   t:random_data
ELSE  input/0
ESAC  , CASE load_memory
      OF   t:address
      ELSE     palmas[2]
      ESAC,          palmas[2], CASE load_memory
                        OF  t:write
                        ELSE     CASE direction
                                 OF   forward:palmas[3][1],
                                      inverse:read
                                 ESAC
                        ESAC)           ->new,
```

```
(ck,reset,CASE direction
     OF   inverse:b"0000000000000000",
          forward:palmas[5]
     ESAC          ,direction,palmas[6][1],palmas[6][2])     ->fifo.

OUTPUT (old_equal#,RMS(ck,reset,cycle,old_inv,new)# )
END.


#test for palmas chip#
TYPE t_int32 = NEW int32/(-2147483000..2147483000).

FN RMS = (bool:ck,t_reset:reset,t_cycle:cycle, t_input:old new)   ->t_int32:
BEGIN

FN I_32 = (t_input:in)  ->t_int32:ARITH in.
FN DV = (t_int32:a b)   ->t_int32:ARITH a%b.
FN PL = (t_int32:a b)   ->t_int32:ARITH a+b.
FN MI = (t_int32:a b)   ->t_int32:ARITH a-b.
FN TI = (t_int32:a b)   ->t_int32:ARITH a*b.

MAKEDFF_INIT(t_int32):old_error.

LET  err = I_32old MI I_32new,
     err2 = (errTIerr) PL  old_error.

JOIN  (ck,reset,CASE cycle
       OFdata_cycle:write
       ELSE read
       ESAC,err2,int32/0)     ->old_error.
```

```
OUTPUT old_error
END.

FN EQ = (t_input:a b)  ->bool:ARITH IF a=b THEN 2
                ELSE 1
                FI.

FN SPARC_MEM = (t_input:in,t_sparc_addr:wr_addr,t_sparc_addr:rd_addr,t_load:rw_sparc#,t_cs:cs#)->t_input:
        RAM(input/0).

FN FIFO     =(bool:ck,t_reset:reset,STRING[16]bit:buffer_in,t_direction:direction,t_load:fifo_read fifo_write)
                ->(STRING[16]bit,[2]t_fifo):    #fifo_full,empty#
BEGIN
      FN  FIFO_RAM = (STRING[16]bit:in,t_inp:wr_addr rd_addr,t_load:rw_fifo)   ->STRING[16]bit:
      RAM(b"0000000000000000").

      FN FULL = (t_inp:in)   ->t_fifo:ARITH IF in>1023 THEN 2   #fifo full#
                    ELSE 1
                    FI.
       FN INCR = (t_inp:in)   ->t_inp:ARITH in+1.

          FN EMPTY = (t_inp:in)   ->t_fifo:ARITH IF in<0 THEN 2  #fifo empty#
                                  ELSE  1
                                  FI.
          FN DECR = (t_inp:in)   ->t_inp:ARITH in-1.


 MAKE DFF(t_inp):address,
    FIFO_RAM:ram.
```

```
LET    next =    CASE direction
       OFforward: CASE fifo_write
              OFwrite:INCR address
              ELSE address
              ESAC,
          inverse:CASE fifo_read
              OFread:INCR address
              ELSE   address
                    ESAC
       ESAC.


JOIN  (ck,reset,next,Inp/0)        ->address,
    (buffer_in ,address,address,CASE direction
                 OF  inverse:read,
                   forward:fifo_write
                 ESAC) ->ram.

OUTPUT     (ram,(FULL address,EMPTY address))
END.

FN TEST_PALMAS = (bool:ck,t_reset:reset, bool:load_memory,t_direction:direction,t_intra:intra_inter,t_channel_factor:channel_factor,
       t_input:q_int,t_quant:quant_norm,t_result:threshold comparison)

       ->(bool,t_int32):


BEGIN

   FN NEW_ADDRESS = (t_sparc_addr:in)       ->t_sparc_addr: ARITH ((in +1) MOD 120000).
```

```
MAKE SPARC_MEM:new old_inv old_forw,
    FIFO:fifo,
    PRBS11:prbs,
    DFF{t_sparc_addr}:address,
    PALMAS:palmas.

LET     col_length = (IN_TO_S{10} input/31)[2],

        row_length= (IN_TO_S{9} input/31)[2],

        ximage_string = (IN_TO_S{10} input/32)[2],

        yimage_string = (IN_TO_S{9} input/32)[2],

        yimage_string_3 = (I_TO_SC{11} result/80)[2],

        pro= palmas[1],

        random_data = BOOL_INT10 prbs,

        frame_done = palmas[7],

        cycle = palmas[8],

        old_equal = CASE cycle
                OF  data_cycle:old_forw EQ  palmas[1]
                ELSE t
                ESAC.
```

```
JOIN
#fix fifo full/empty logic later#
(ck,reset,direction,intra_inter,channel_factor,q_int,quant_norm,fifo[1],new,CASE direction
                                OF forward:old_forw
                                ELSE old_inv
                                ESAC, threshold,comparison,
#fifo[2][1],fifo[2][2]#ok_fifo,ok_fifo, col_length,row_length,ximage_string,yimage_string, yimage_string_3)
                        ->palmas,

(ck,reset,(NEW_ADDRESS address) ,addr/0)            -> address,

(ck,resel)                      ->prbs,

#old forward mem, on forward use as normal, on inverse read values to compare with inverse#
(CASE load_memory
OFt:DFF(t_input)(ck,reset,random_data,input/0)
ELSE palmas[1]
ESAC , CASE load_memory
    OF    t:address
    ELSE  palmas[2]
    ESAC,     palmas[2], CASE load_memory
                OF  t:write
                ELSE  CASE direction
                    OF   forward:palmas[4][1],
                      inverse:read
                    ESAC
              ESAC)          ->old_forw,

(CASE load_memory
OF    t:DFF(t_input)(ck,reset,random_data,input/0)
ELSE  palmas[1]
```

```
ESAC   , CASE load_memory
      OF    t:address
      ELSE      palmas[2]
      ESAC,           palmas[2], CASE load_memory
                        OF  t:write
                        ELSE      CASE direction
                                OF   forward:palmas[4][1],
                                     inverse:read
                                ESAC
                        ESAC)           ->old_inv,

(CASE load_memory
OF    t:random_data
ELSE  input/0
ESAC   , CASE load_memory
      OF    t:address
      ELSE      palmas[2]
      ESAC,           palmas[2], CASE load_memory
                        OF  t:write
                        ELSE      CASE direction
                                OF   forward:palmas[3][1],
                                     inverse:read
                                ESAC
                        ESAC)           ->new,



(ck,reset,CASE direction
     OF   inverse:b"0000000000000000",
          forward:palmas[5]
```

```
ESAC        ,direction,palmas[6][1],palmas[6][2])    ->fifo.

OUTPUT (old_equal,RMS(ck,reset,cycle,old_inv,new) )
END.
```

APPENDIX C

```
7/22/93 3:39 PM        Engineering:KlicsCode:CompPict:Top.a

*---------------------------------
*
*   © Copyright 1993 KLICS Limited
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*
*   Written by: Adrian Lewis
*
*---------------------------------
*
*   680X0 Fast Top Octave
*
*---------------------------------
        seg         'klics'

        macro
        TOPX        &DG, &HG, &old, &XX
*
        swap        &HG                     ; HG=G1H0
        move.w      &DG,&XX                 ; XX=G0
        neg.w       &DG                     ; DG=D(-G0)
        add.w       &HG,&DG                 ; DG=DD
        add.w       &XX,&HG                 ; HG=G1D
        swap        &HG                     ; HG=DG1
        move.l      &DG,&old                ; save DD
*
        endm
*---------------------------------
        macro
        TOPY        &HG0, &new0, &HG1, &new1, &XX
*
        move.l      &new0,&XX               ; read HG
        move.l      &new1,&HG1              ; read HG
        move.l      &HG1,&HG0               ; copy HG
        add.l       &XX,&HG1                ; new1=H1G1
        sub.l       &XX,&HG0                ; new0=H0G0
*
        endm
*---------------------------------
        macro
        TOPBLOCK    &DG0, &HG0, &new0, &old0, &DG1, &HG1, &new1, &old1, &XX
*
        TOPY        &HG0,&new0,&HG1,&new1,&XX
        TOPX        &DG0,&HG0,&old0,&XX
        TOPX        &DG1,&HG1,&old1,&XX
*
        endm
*---------------------------------
        macro
        TOPH        &DG, &HG, &new, &old, &XX
*
        move.l      &new,&HG
        TOPX        &DG,&HG,&old,&XX
*
        endm
*---------------------------------
        macro
        TOPE        &DG, &old, &XX
*
        move.l      &DG,&XX                 ; XX=DG
        swap        &XX                     ; XX=GD
        move.w      &XX,&DG                 ; DG=DD
        move.l      &DG,&old                ; save DD
*
```

Engineering:KlicsCode:CompPict:Top.a

```
        endm
;-------------------------------
TopBwd  FUNC    EXPORT
;
PS      RECORD  0
src     DS.L    1
dst     DS.L    1
width   DS.L    1
height  DS.L    1
        ENDR
;
        link    a6,#0                   ; no local variables
        movem.l d4-d7/a3-a5,-(a7)       ; store registers
;
        movea.l PS.src(a6),a0           ; read src
        move.l  PS.height(a6),d7        ; read height
        move.l  PS.width(a6),d6         ; read width
;       move.l  a0,a1
        move.l  PS.dst(a6),a1           ; read dst

        move.l  d6,d5                   ; inc = width
        add.l   d5,d5                   ; inc*=2
        move.l  d5,a4                   ; save inc

        lsr.l   #1,d7                   ; height/=2
        subq.l  #2,d7                   ; height-=2

        lsr.l   #2,d6                   ; width/=4
        subq.l  #2,d6                   ; width-=2

        move.l  d6,d5                   ; ccount=width
        move.l  (a0)+,d0                ; d0=*new0++

@do1    TOPH    d0,d1,(a0)+,(a1)+,d4
        TOPH    d1,d0,(a0)+,(a1)+,d4
        dbf     d5,@do1                 ; while -1!=--ccount
        TOPH    d0,d1,(a0)+,(a1)+,d4
        TOPE    d1,(a1)+,d4

@do2    move.l  a0,a2                   ; new0=new1
        move.l  a1,a3                   ; old0=old1
        adda.l  a4,a0                   ; new1+=inc
        adda.l  a4,a1                   ; old1+=inc
        move.l  d6,d5                   ; ccount=width
        TOPY    d2,(a2)+,d0,(a0)+,d4

@do3    TOPBLOCK d2,d3,(a2)+,(a3)+,d0,d1,(a0)+,(a1)+,d4
        TOPBLOCK d3,d2,(a2)+,(a3)+,d1,d0,(a0)+,(a1)+,d4
        dbf     d5,@do3                 ; while -1!=--ccount

        TOPBLOCK d2,d3,(a2)+,(a3)+,d0,d1,(a0)+,(a1)+,d4
        TOPE    d1,(a1)+,d4
        TOPE    d3,(a3)+,d4
        dbf     d7,@do2                 ; while -1!=--height

        move.l  d6,d5                   ; ccount=width
        add.l   #1,d5                   ; d0=*new0++

@do4    move.l  (a3)+,(a1)+             ; copy prev line
        move.l  (a3)+,(a1)+
        dbf     d5,@do4                 ; while -1!=--ccount

        movem.l (a7)+,d4-d7/a3-a5       ; restore registers
```

```
                    Engineering:KlicsCode:CompPict:Top.a

        unlk        a6                      ; remove locals
        rts                                 ; return

        ENDFUNC
;-------------------------------
        END
```

Engineering:KlicsCode:CompPict:Table.a

```
*--------------------------------
*
*   © Copyright 1993 KLICS Ltd.
*   All rights reserved.
*
*--------------------------------
*
*   680X0 Table Lookup RGB/YUV code
*
*--------------------------------

        machine     MC68030
        seg         'klics'

        if  &TYPE('seg')<>'UNDEFINED' then
        seg         &seg
        endif

MKTABLE FUNC    EXPORT
*
PS      RECORD      8
Table   DS.L        1
        ENDR
*
        link        a6,#0                   ;
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.Table(a6),a0         ;Table is (long)(2U+512) (long)(512-(6
        clr.l       d0                      ;U value
@MakeLoop
        move.w      #512,d1                 ;512

        move.l      d0,d2                   ;U
        move.w      d2,d3                   ;U

        add.w       d2,d2                   ;2U
        add.w       d1,d2                   ;2U + 512

        lsr.w       #2,d2
        move.w      d2,(a0)+                ;Place 1st word
        move.w      d2,(a0)+                ;Place 2nd word

        add.w       d3,d3                   ;2U
        move.w      d3,d2                   ;2U
        add.w       d3,d3                   ;4U
        add.w       d2,d3                   ;6U
        asr.w       #4,d3                   ;6U/16
        sub.w       d3,d1                   ;512 - (6U/16)

        lsr.w       #2,d1
        move.w      d1,(a0)+                ;Place 1st word
        move.w      d1,(a0)+                ;Place 2nd word

        add.w       #1,d0
        cmp.w       #$0200,d0
        bne         @MakeLoop

        move.l      #$00000200,d0           ;U value
        clr.l       d4
@MakeNegLoop
        move.w      #512,d1                 ;512

        move.w      d0,d2                   ;U
```

Engineering:KlicsCode:CompPict:Table.a

```
        or.w        #$FC00,d2
        move.w      d2,d3                   ;U

        add.w       d2,d2                   ;2U
        add.w       d1,d2                   ;2U + 512

        asr.w       #2,d2
        move.w      d2,(a0)+                ;Place 1st word
        move.w      d2,(a0)+                ;Place 2nd word
        add.w       d3,d3                   ;2U
        move.w      d3,d2                   ;2U
        add.w       d3,d3                   ;4U
        add.w       d2,d3                   ;6U
        asr.w       #4,d3                   ;6U/16
        sub.w       d3,d1                   ;512 - (6U/16)

        asr.w       #2,d1
        move.w      d1,(a0)+                ;Place 1st word
        move.w      d1,(a0)+                ;Place 2nd word

        add.l       #1,d0
        add.l       #1,d4
        cmp.w       #$0200,d4
        bne         @MakeNegLoop
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*---------------------------------
        macro
        FIXOV       &V, &SP1, &SP2
*
        move.w      &V,&SP1
        clr.b       &SP1
        andi.w      #$3FFF,&SP1
        sne         &SP1
        btst        #13,&SP1
        seq         &SP2
        or.b        &SP1,&V
        and.w       &SP2,&V
        swap        &V
        move.w      &V,&SP1
        clr.b       &SP1
        andi.w      #$3FFF,&SP1
        sne         &SP1
        btst        #13,&SP1
        seq         &SP2
        or.b        &SP1,&V
        and.w       &SP2,&V
        swap        &V
*
        endm
*---------------------------------
        if  &TYPE('seg')<>'UNDEFINED' then
        seg         &seg
        endif

YUV2RGB4    FUNC    EXPORT
*
PS      RECORD      8
Table   DS.L        1
```

Engineering:KlicsCode:CompPict:Table.a

```
pixmap  DS.L    =  1
Y       DS.L       1
U       DS.L       1
V       DS.L       1
area    DS.L       1
width   DS.L       1
cols    DS.L       1
        ENDR
*
LS      RECORD     0,DECR
inc     DS.L       1
width   DS.L       1
fend    DS.L       1
count   DS.L       1
LSize   EQU        *
        ENDR
*
*void YUVtoRGB(Ptr TablePtr,long *pixmap,short *Yc,short *Uc,short *Vc,long area,l
*{
*long       inc,lwidth,fend,count;
;       a0 - Y0, a1 - Y1, a2 - U, a3 - V, a4 - pm0, a5 - pm1
;       d0..6 - used, d7 - count

        link        a6,#LS.LSize            ; save locals
        movem.l     d0-d7/a0-a5,-(a7)       ; store registers

        move.l      PS.pixmap(a6),a4        ; pm0=pixmap
        move.l      a4,a5                   ; pm1=pm0
        move.l      PS.Y(a6),a0             ; Y0=Yc
        move.l      a0,a1                   ; Y1=Y0
        move.l      PS.U(a6),a2             ; U=Uc
        move.l      PS.V(a6),a3             ; V=Vc
        move.l      PS.area(a6),d7          ; fend=area
        lsl.l       #2,d7                   ; fend<<=2
        add.l       a4,d7                   ; fend+=pm0
        move.l      d7,LS.fend(a6)          ; save fend
        move.l      PS.width(a6),d5         ; width=width
        move.l      d5,d7                   ; count=width
        asr.l       #1,d7                   ; count>>=1
        subq.l      #1,d7                   ; count-=1
        move.l      d7,PS.width(a6)         ; save width

        add.l       d5,d5                   ; width*=2
        add.l       d5,a1                   ; Y1+=width
        add.l       d5,d5                   ; width*=2
        move.l      d5,LS.width(a6)         ; save width

        move.l      PS.cols(a6),d4          ; inc=cols
        lsl.l       #2,d4                   ; inc<<=2
        add.l       d4,a5                   ; pm1+=inc
        add.l       d4,d4                   ; cols*=2
        sub.l       d5,d4                   ; inc now 2*cols-width bytes
        move.l      d4,LS.inc(a6)           ; save inc

        move.l      a6,-(sp)
        move.l      PS.Table(a6),a6

; Colors wanted are:
;   RED     = (Y + 2V - 512) / 4                UTable part is for  (2V - 512)
;   GREEN   = (Y - V + 512 - (6U/16)) / 4       UTable part is for  (512 - (6U
;   BLUE    = (Y + 2U - 512) / 4                UTable part is for  (2U - 512)
;
#do     ; uv2rgb(*U++,*V++)
```

Engineering:KlicsCode:CompPict:Table.a

```
        d1 - ra, d2 - ga, d3 - ba,    d4 - rb, d5 - gb/512, d6 - bb

        move.w      (a2)+,d2                ; U
        beq         @DoQuickU
        and.w       #$03FF,d2
        move.l      (a6,d2.w*8),d3          ;BLUE,Get (2U + 512)/4 for Blue = (Y +
        move.l      d3,d6                   ;Dup for second pair
        move.l      4(a6,d2.w*8),d5         ;GREEN, Get (512 - (6U/16))/4 for Gree
@DidQuickU
        move.w      (a3)+,d1                ; V
        beq         @DoQuickV               ;if zero then handle using the quick m
        move.w      d1,d4
        asr.w       #2,d1
        sub.w       d1,d5                   ;GREEN, Get (512 - (6U/16) - V)/4 for
        move.w      d5,d2
        swap        d5
        move.w      d2,d5
        move.l      d5,d2                   ;Dup for second pair

        and.w       #$03FF,d4
        move.l      (a6,d4.w*8),d4          ;RED, Get (2V + 512)/4 for Red = (Y +
        move.l      d4,d1
        bra         @TestEnd

@DoQuickU
        move.l      #$00800080,d3           ;BLUE,Get (2U + 512)/4 for Blue = (Y +
        move.l      d3,d6                   ;Dup for second pair
        move.l      d3,d5                   ;GREEN, Get (512 - (6U/16))/4 for Gree
        bra         @DidQuickU

@DoQuickV
        move.l      d5,d2                   ;GREEN, Get (512 - (6U/16) - V)/4 for
        move.l      #$00800080,d4           ;RED, Get (2V + 512)/4 for Red = (Y +
        move.l      d4,d1                   ;Dup for second pair

@TestEnd

        ; add Ya to RGB values - FETCHY (a0)+,d0,d1,d2,d3
        move.l      (a0)+,d0                ;Y
        asr.w       #2,d0
        swap        d0
        asr.w       #2,d0
        swap        d0                      ;Y is       -128 to +127
        add.l       d0,d1                   ;RED, Get (Y+ 2V + 512) for Red = (Y +
        add.l       d0,d2                   ;GREEN, Get (Y + (512 - (6U/16)) - V)
        add.l       d0,d3                   ;BLUE,Get (Y + (2U + 512) for Blue = (

        ; add Yb to RGB values - FETCHY2 (a1)+,d0,d4,d5,d6
        move.l      (a1)+,d0                ;Y
        asr.w       #2,d0
        swap        d0
        asr.w       #2,d0
        swap        d0                      ;Y is       -128 to +127
        add.l       d0,d4                   ;RED, Get (Y+ 2V + 512) for Red = (Y +
        add.l       d0,d5                   ;GREEN, Get (Y + (512 - (6U/16)) - V)
        add.l       d0,d6                   ;BLUE,Get (Y + (2U + 512) for Blue = (

        move.l      d1,d0
        or.l        d4,d0

        or.l        d2,d0
        or.l        d3,d0
        or.l        d5,d0
```

```
                Engineering:KlicsCode:CompFict:Table.a

        or.l    d6,d0

        and.l   #$FF00FF00,d0
        bne     @over                   ; if overflow

@ok     ; save RGBa - MKRGB d1,d2,d3,(a4)+
        lsl.l   #8,d2                   ; G=G0G0 (12)
        or.l    d3,d2                   ; G=GBGB (12)
        move.l  d1,d3                   ; B=0R0R (12)
        swap    d3                      ; B=0R0R (21)
        move.w  d2,d3                   ; B=0RGB (2)
        swap    d2                      ; G=GBGB (21)
        move.w  d2,d1                   ; R=0RGB (1)
        move.l  d1,(a4)+                ; *RGB++=rgb (1)
        move.l  d3,(a4)+                ; *RGB++=rgb (2)

        ; save RGBb - MKRGB d4,d5,d6,(a5)+
        lsl.l   #8,d5                   ; G=G0G0 (12)
        or.l    d6,d5                   ; G=GBGB (12)
        move.l  d4,d6                   ; B=0R0R (12)
        swap    d6                      ; B=0R0R (21)
        move.w  d5,d6                   ; B=0RGB (2)
        swap    d5                      ; G=GBGB (21)
        move.w  d5,d4                   ; R=0RGB (1)
        move.l  d4,(a5)+                ; *RGB++=rgb (1)
        move.l  d6,(a5)+                ; *RGB++=rgb (2)

        dbf     d7,@do                  ; while

        move.l  (sp)+,a6

        adda.l  LS.inc(a6),a4           ; pm0+=inc
        adda.l  LS.inc(a6),a5           ; pm1+=inc
        adda.l  LS.width(a6),a0         ; Y0+=width
        exg.l   a0,a1                   ; Y1<->Y0
        move.l  PS.width(a6),d7         ; count=width
        cmpa.l  LS.fend(a6),a4          ; pm0<fend
        blt.w   @do2                    ; while

        movem.l (a7)+,d0-d7/a0-a5       ; restore registers
        unlk    a6                      ; remove locals
        rts

@do2
        move.l  a6,-(sp)
        move.l  PS.Table(a6),a6
        bra     @do                     ; return


@FixIt
        btst    #31,d0                  ;See if upper word went negative
        beq     @D1TopNotNeg
        and.l   #$0000FFFF,d0           ;Pin at zero
@D1TopNotNeg
        btst    #24,d0                  ;See if upper word went too positive
        beq     @D1TopNotPos
        and.l   #$0000FFFF,d0           ;Mask old data out
        or.l    #$00FF0000,d0           ;New data is maxed
@D1TopNotPos

        btst    #15,d0                  ;See if lower word went negative
        beq     @D1BotNotNeg
```

```
                    Engineering:KlicsCode:CompPict:Table.a

        and.l       #$FFFF0000,d0           ;Pin at zero
@D1BotNotNeg    >
        btst        #8,d0                   ;See if lower word went too positive
        beq         @D1BotNotPos
        and.l       #$FFFF0000,d0           ;Mask old data out
        or.l        #$000000FF,d0           ;New data is maxed
@D1BotNotPos
        rts


@over
        move.l      d1,d0
        bsr         @FixIt
        move.l      d0,d1

        move.l      d2,d0
        bsr         @FixIt
        move.l      d0,d2

        move.l      d3,d0
        bsr         @FixIt
        move.l      d0,d3

        move.l      d4,d0
        bsr         @FixIt
        move.l      d0,d4

        move.l      d5,d0
        bsr         @FixIt
        move.l      d0,d5

        move.l      d6,d0
        bsr         @FixIt
        move.l      d0,d6

        bra         @ok

        ENDFUNC
;--------------------------------
        END
```

Engineering:KlicsCode:CompPict:KlicsUtil.a

```
*--------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*--------------------------------
*
*   68000 Klics Utilities
*
*--------------------------------
        seg     'klics'

KLCopy  FUNC    EXPORT
*
*   KLCOPY(short *src, short *dst, int area);
*
PS      RECORD      8
src     DS.L        1
dst     DS.L        1
end     DS.L        1
        ENDR
*
        link        a6,#0                   ; no local variables
*
        move.l      PS.src(a6),a0           ; short *src
        move.l      PS.dst(a6),a1           ; short *dst
        move.l      PS.end(a6),d3           ; long area
        lsr.l       #4,d3                   ; in words(x8)
        subq.l      #1,d3                   ; area-=1
@do     move.l      (a0)+,(a1)+             ; *dst++=*src++
        move.l      (a0)+,(a1)+             ; *dst++=*src++
        move.l      (a0)+,(a1)+             ; *dst++=*src++
        move.l      (a0)+,(a1)+             ; *dst++=*src++
        move.l      (a0)+,(a1)+             ; *dst++=*src++
        move.l      (a0)+,(a1)+             ; *dst++=*src++
        move.l      (a0)+,(a1)+             ; *dst++=*src++
        move.l      (a0)+,(a1)+             ; *dst++=*src++
        dbf         d3,@do                  ; if -1!=--area goto do
*
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*--------------------------------
KLHalf  FUNC    EXPORT
*
*   KLHALF(short *src, short *dst, long width, long height);
*   Dimensions of dst (width, height) are half that of src
*
PS      RECORD      8
src     DS.L        1
dst     DS.L        1
width   DS.L        1
height  DS.L        1
        ENDR
*
        link        a6,#0                   ; no local variables
        movem.l     d4,-(a7)                ; store registers
*
        move.l      PS.src(a6),a0           ; short *src
        move.l      PS.dst(a6),a1           ; short *dst
```

Engineering:KlicsCode:CompPict:KlicsUtil.a

```
        move.l      PS.width(a6),d2         ; long width
        move.l      PS.height(a6),d3        ; long height
        subq.l      #1,d3                   ; height-=1
@do_y   move.l      d2,d4                   ; count=width
        lsr.l       #2,d4                   ; count /= 2
        subq.l      #1,d4                   ; count-=1
@do_x   move.l      (a0)+,d0                ; d0=*src++
        move.w      (a0)+,d0                ; d2=*src++
        addq.l      #2,a0                   ; src+=1 short
        move.l      d0,(a1)+                ; *dst++=d0
        move.l      (a0)+,d0                ; d0=*src++
        move.w      (a0)+,d0                ; d2=*src++
        addq.l      #2,a0                   ; src+=1 short
        move.l      d0,(a1)+                ; *dst++=d0
        dbf         d4,@do_x                ; if -1!=--width goto do_x
        adda.l      d2,a0                   ; skip a quarter row
        adda.l      d2,a0                   ; skip a quarter row
        adda.l      d2,a0                   ; skip a quarter row
        adda.l      d2,a0                   ; skip a quarter row
        dbf         d3,@do_y                ; if -1!=--height goto do_y
*
        movem.l     (a7)+,d4                ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*---------------------------------
KLZero  FUNC    EXPORT
*
*   KLZERO(short *data, int area);
*
PS      RECORD      8
data    DS.L        1
end     DS.L        1
        ENDR
*
        link        a6,#0                   ; no local variables
*
        move.l      PS.data(a6),a0          ; short *data
        move.l      PS.end(a6),d3           ; long area
        lsr.l       #3,d3                   ; in words(x4)
        subq.l      #1,d3                   ; area-=1
@do     clr.l       (a0)+                   ; *dst++=*src++
        clr.l       (a0)+                   ; *dst++=*src++
        clr.l       (a0)+                   ; *dst++=*src++
        clr.l       (a0)+                   ; *dst++=*src++
        dbf         d3,@do                  ; if -1!=--area goto do
*
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*---------------------------------
CLEARA2 FUNC    EXPORT
*
        move.l      #0,a2
        rts
*
        END
```

Engineering:KlicsCode:CompPict:KlicsEncode.h

```
/*********************************
 *
 *  © Copyright 1993 KLICS Limited
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 *
 *  Written by: Adrian Lewis
 *
 *********************************/
typedef struct {
    int     bpf_in,     /* User - Bytes per frame in input stream */
            bpf_out,    /* User - Bytes per frame in output stream */
            buf_size;   /* User - Buffer size (bytes) */

    Boolean intra,      /* Calc - Compression mode intra/inter */
            auto_q,     /* User - Automatic quantization for rate control */
            buf_sw;     /* User - Theoretical buffer on/off */

    float   quant,      /* User - Starting quantiser value */
            thresh,     /* User - Threshold factor */
            compare,    /* User - Comparison factor */
            base[5];    /* User - Octave weighting factors */

    int     buffer,     /* Calc - Current buffer fullness (bytes) */
            prevbytes,  /* Calc - Bytes sent last frame */
            prevquact;  /* Calc - Quantisation/activity for last frame */

    double  tmp_quant;  /* Calc - Current quantiser value quant */
} KlicsEDataRec;

typedef struct {
    KlicsSeqHeader      seqh;
    KlicsFrameHeader    frmh;
    KlicsEDataRec       encd;
    Buffer              buf;
} KlicsERec, *KlicsE;
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
*--------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*--------------------------------
*
*   680X0 KlicsDecode code
*   Fast code for:
*       3/2 octave input stream
*       2/1 octave output image
*
*--------------------------------

        seg         'klics'
        include     'Bits3.a'
        include     'Traps.a'

*--------------------------------
        machine     MC68030

********************************
*
*   Data stream readers:
*
*   XDELTA, XVALUE, SKIPHUFF, XINT
*
********************************
        macro
        XDELTA      &addr,&step,&ptr,&data,&bno,&spare
*
        buf_rinc    &ptr,&data,&bno         ;
        buf_get     &data,&bno              ;
        beq.s       @quit                   ; if zero write
        moveq       #6,&spare               ; set up count
        buf_get     &data,&bno              ; read sign
        bne.s       @doneg                  ; if negative -> doneg

@dopos  buf_get     &data,&bno
        dbne        &spare,@dopos           ; if --spare!=-1
        bne.s       @fndpos

        move.l      &data,&spare            ; spare=data
        subq.b      #7,&bno                 ; bno-=6
        lsr.l       &bno,&spare             ; spare>>=bno
        andi.w      #$007F,&spare           ; spare AND= mask
        add.w       #8,&spare               ; spare+=9
        bra.s       @write

@fndpos neg.w       &spare                  ; bits-=bits
        addq.l      #7,&spare               ; bits+=8
        bra.s       @write

@doneg  buf_get     &data,&bno
        dbne        &spare,@doneg           ; if --spare!=-1
        bne.s       @fndneg

        move.l      &data,&spare            ; spare=data
        subq.b      #7,&bno                 ; bno-=6
        lsr.l       &bno,&spare             ; spare>>=bno
        andi.w      #$007F,&spare           ; spare AND= mask
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
        add.w =     #8,&spare               ; spare+=9
        neg.w       &spare
        bra.s       @write

@fndneg subq.l      #7,&spare               ; level-=8

@write  lsl.w       &step,&spare            ; level<<=step
        swap        &step
        add.w       &step,&spare
        swap        &step
        add.w       &spare,&addr            ; *addr=delta
@quit
*
        endm

        macro
        XVAL0       &addr,&step,&ptr,&data,&bno,&spare
*
        clr.w       &spare
        buf_rinc    &ptr,&data,&bno         ;
        buf_get     &data,&bno              ;
        beq.s       @quit                   ; if zero write
        moveq       #6,&spare               ; set up count
        buf_get     &data,&bno              ; read sign
        bne.s       @doneg                  ; if negative -> doneg

@dopos  buf_get     &data,&bno
        dbne        &spare,@dopos           ; if --spare!=-1
        bne.s       @fndpos

        move.l      &data,&spare            ; spare=data
        subq.b      #7,&bno                 ; bno-=6
        lsr.l       &bno,&spare             ; spare>>=bno
        andi.w      #$007F,&spare           ; spare AND= mask
        add.w       #8,&spare               ; spare+=9
        bra.s       @write

@fndpos neg.w       &spare                  ; bits-=bits
        addq.l      #7,&spare               ; bits+=8
        bra.s       @write

@doneg  buf_get     &data,&bno
        dbne        &spare,@doneg           ; if --spare!=-1
        bne.s       @fndneg

        move.l      &data,&spare            ; spare=data
        subq.b      #7,&bno                 ; bno-=6
        lsr.l       &bno,&spare             ; spare>>=bno
        andi.w      #$007F,&spare           ; spare AND= mask
        add.w       #8,&spare               ; spare+=9
        neg.w       &spare
        bra.s       @write

@fndneg subq.l      #7,&spare               ; level-=8

@write  lsl.w       &step,&spare            ; level<<=step
        swap        &step
        add.w       &step,&spare
        swap        &step
        move.w      &spare,&addr            ; *addr=level
@quit
*
        endm
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
          macro
          XVAL1       &addr,&step,&ptr,&data,&bno,&spare

          clr.w       &spare
          buf_rinc    &ptr,&data,&bno          ;
          buf_get     &data,&bno               ;
          beq.s       @quit                    ; if zero write
          moveq       #6,&spare                ; set up count
          buf_get     &data,&bno               ; read sign
          bne.s       @doneg                   ; if negative -> doneg

@dopos    buf_get     &data,&bno
          dbne        &spare,@dopos            ; if --spare!=-1
          bne.s       @fndpos

          move.l      &data,&spare             ; spare=data
          subq.b      #7,&bno                  ; bno-=6
          lsr.l       &bno,&spare              ; spare>>=bno
          andi.w      #$007F,&spare            ; spare AND= mask
          add.w       #8,&spare                ; spare+=9
          bra.s       @write

@fndpos   neg.w       &spare                   ; bits-=bits
          addq.l      #7,&spare                ; bits+=8
          bra.s       @write

@doneg    buf_get     &data,&bno
          dbne        &spare,@doneg            ; if --spare!=-1
          bne.s       @fndneg

          move.l      &data,&spare             ; spare=data
          subq.b      #7,&bno                  ; bno-=6
          lsr.l       &bno,&spare              ; spare>>=bno
          andi.w      #$007F,&spare            ; spare AND= mask
          add.w       #8,&spare                ; spare+=9
          neg.w       &spare
          bra.s       @write

@fndneg   subq.l      #7,&spare                ; level-=8

@write    lsl.w       &step,&spare             ; level<<=step
@quit     move.w      &spare,&addr             ; *addr=level

          endm

          macro
          SKIPHUFF      &ptr,&data,&bno,&spare

          buf_get     &data,&bno               ;
          beq.s       @quit                    ; if zero quit
          buf_get     &data,&bno               ; skip sign
          moveq       #6,&spare                ; set up count

@do       buf_get     &data,&bno
          dbne        &spare,@do               ; if --spare!=-1
          bne.s       @end

          subq.b      #7,&bno                  ; bno-=6
@end      buf_rinc    &ptr,&data,&bno          ; fill buffer
@quit

          endm
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
        macro
        XINTX       &bits,&addr,&step,&ptr,&data,&bno
*
*   Note: half_q is missing
*
        buf_rinc    &ptr,&data,&bno         ;
        move.l      &data,d0                ; result=data
        sub.b       &bits,&bno              ; d1-=bits-1
        subq.b      #1,&bno                 ; d1-=1
        lsr.l       &bno,d0                 ; result>>=bno
        clr.l       d1                      ; d1=0
        bset        &bits,d1                ; d1[bits]=1
        subq.l      #1,d1                   ; d1=mask
        btst        &bits,d0                ; sign?
        beq.s       @pos                    ; if positive goto pos
        and.l       d1,d0                   ; apply mask leaving level
        neg.l       d0                      ; level-=level
        bra.s       @cont                   ; goto cont
@pos    and.l       d1,d0                   ; apply mask leaving level
@cont   lsl.l       &step,d0                ; level<<=step
        move.w      d0,&addr                ; *addr=result
*
        endm

        macro
        XINT        &bits,&addr,&step,&ptr,&data,&bno
*
*   Hardware compatable version: sign mag(lsb->msb)
*
        buf_rinc    &ptr,&data,&bno         ;
        move.l      &data,d0                ; result=data
        sub.b       &bits,&bno              ; d1-=bits-1
        subq.b      #1,&bno                 ; d1-=1
        lsr.l       &bno,d0                 ; temp>>=bno
        clr.l       d1                      ; result=0
        swap        &bno                    ; use free word
        move.w      &bits,&bno              ; bno=bno.bits
        subq.w      #1,&bno                 ; count=bits-2
@shft   lsr.l       #1,d0                   ; shift msb from temp
        roxl.l      #1,d1                   ; into lsb of result
        dbf         &bno,@shft              ; for entire magnitude
        swap        &bno                    ; restore bno
        btst        #0,d0                   ; sign test
        beq.s       @pos                    ; if positive -> pos
        neg.l       d1                      ; result= -result
@pos    lsl.l       &step,d1                ; result<<=step
        move.w      d1,&addr                ; *addr=result
*
        endm

*********************************
*
*   Block data read/write:
*
*   VOID, STILL, SEND, LPFSTILL
*
*********************************

        macro
        VOID        &x_blk, &y_blk
*
        clr.w       (a2)
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
        addq.l  #  &x_blk,a2              ; caddr+=x_blk
        clr.w      (a2)
        adda.w     &y_blk,a2              ; caddr+=y_blk
        clr.w      (a2)
        addq.l     &x_blk,a2              ; caddr+=x_blk
        clr.w      (a2)

        endm

        macro
        STILL      &x_blk, &y_blk, &step

        XVAL0      (a2),&step,a0,d6,d7,d0
        addq.l     &x_blk,a2              ; caddr+=x_blk
        XVAL0      (a2),&step,a0,d6,d7,d0
        adda.w     &y_blk,a2              ; caddr+=y_blk
        XVAL0      (a2),&step,a0,d6,d7,d0
        addq.l     &x_blk,a2              ; caddr+=x_blk
        XVAL0      (a2),&step,a0,d6,d7,d0

        endm

        macro
        STILLSEND  &x_blk, &y_blk, &step

        XVAL1      (a2),&step,a0,d6,d7,d0
        addq.l     &x_blk,a2              ; caddr+=x_blk
        XVAL1      (a2),&step,a0,d6,d7,d0
        adda.w     &y_blk,a2              ; caddr+=y_blk
        XVAL1      (a2),&step,a0,d6,d7,d0
        addq.l     &x_blk,a2              ; caddr+=x_blk
        XVAL1      (a2),&step,a0,d6,d7,d0

        endm

        macro
        SEND       &x_blk,&y_blk,&step

        XDELTA     (a2),&step,a0,d6,d7,d0
        addq.l     &x_blk,a2              ; caddr+=x_blk
        XDELTA     (a2),&step,a0,d6,d7,d0
        adda.w     &y_blk,a2              ; caddr+=y_blk
        XDELTA     (a2),&step,a0,d6,d7,d0
        addq.l     &x_blk,a2              ; caddr+=x_blk
        XDELTA     (a2),&step,a0,d6,d7,d0

        endm

        macro
        LPFSTILL   &x_blk, &y_blk, &step, &bits

        XINT       &bits,(a2),&step,a0,d6,d7   ; ReadInt (at baddr)
        addq.l     &x_blk,a2                   ; caddr+=x_blk
        XINT       &bits,(a2),&step,a0,d6,d7   ; ReadInt
        adda.w     &y_blk,a2                   ; caddr+=y_blk
        XINT       &bits,(a2),&step,a0,d6,d7   ; ReadInt
        addq.l     &x_blk,a2                   ; caddr+=x_blk
        XINT       &bits,(a2),&step,a0,d6,d7   ; ReadInt

        endm

.....
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
*   Data skipping:
*
*   SKIP4, STILLSKIP, SS_SKIP, SENDSKIP
*
.....................................

SKIP4   FUNC    EXPORT
*
        buf_rinc    a0,d6,d7            ; fill buffer
        SKIPHUFF    a0,d6,d7,d0
        SKIPHUFF    a0,d6,d7,d0
        SKIPHUFF    a0,d6,d7,d0
        SKIPHUFF    a0,d6,d7,d0
        rts
*
        ENDFUNC

STILLSKIP   FUNC    EXPORT
*
        buf_rinc    a0,d6,d7            ; BUF_INC
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk1                ; if 0 the STOP
        bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC
@sk1    buf_get     d6,d7               ; BUF_GET
        beq.s       @sk2                ; if 0 the STOP
        bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC
@sk2    buf_get     d6,d7               ; BUF_GET
        beq.s       @sk3                ; if 0 the STOP
        bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC
@sk3    buf_get     d6,d7               ; BUF_GET
        beq.s       @nxt                ; if 0 the STOP
        bsr         SKIP4
@nxt    rts
*
        ENDFUNC

SS_SKIP FUNC    EXPORT
*
        buf_rinc    a0,d6,d7            ; BUF_INC
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk1                ; if 0 then STOP
        buf_get     d6,d7               ; BUF_GET
        bne.s       @sk1                ; if 1 then VOID
        bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC
@sk1    buf_get     d6,d7               ; BUF_GET
        beq.s       @sk2                ; if 0 then STOP
        buf_get     d6,d7               ; BUF_GET
        bne.s       @sk2                ; if 1 then VOID
        bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC
@sk2    buf_get     d6,d7               ; BUF_GET
        beq.s       @sk3                ; if 0 then STOP
        buf_get     d6,d7               ; BUF_GET
        bne.s       @sk3                ; if 1 then VOID
        bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC
@sk3    buf_get     d6,d7               ; BUF_GET
        beq.s       @nxt                ; if 0 then STOP
        buf_get     d6,d7               ; BUF_GET
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
        bne.s   @nxt                    ; if 1 then VOID
        bsr     SKIP4
@nxt    rts
*
        ENDFUNC

SENDSKIP    FUNC    EXPORT
*
        buf_rinc    a0,d6,d7            ; BUF_INC

        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk1                ; if 0 the STOP
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk0                ; if 0 then STILLSEND
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk1                ; if 0 then VOID

@sk0    bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC

@sk1    buf_get     d6,d7               ; BUF_GET
        beq.s       @sk3                ; if 0 the STOP
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk2                ; if 0 then STILLSEND
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk3                ; if 0 then VOID

@sk2    bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC

@sk3    buf_get     d6,d7               ; BUF_GET
        beq.s       @sk5                ; if 0 the STOP
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk4                ; if 0 then STILLSEND
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk5                ; if 0 then VOID

@sk4    bsr         SKIP4
        buf_rinc    a0,d6,d7            ; BUF_INC

@sk5    buf_get     d6,d7               ; BUF_GET
        beq.s       @nxt                ; if 0 then STOP
        buf_get     d6,d7               ; BUF_GET
        beq.s       @sk6                ; if 0 then STILLSEND
        buf_get     d6,d7               ; BUF_GET
        beq.s       @nxt                ; if 0 then VOID

@sk6    bsr         SKIP4
@nxt    rts
*
        ENDFUNC

*********************************
*
*   Octave Processing:
*
*   DOSTILL0, DOSEND0, DOSTILL1,
*   DOVOID1, DOSTILLSEND1, DOSEND1
*
*********************************

DOSTILL0    FUNC    EXPORT
*
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
            buf_rinc    a0,d6,d7                ; BUF_INC
            buf_get     d6,d7                   ; BUF_GET
            bne.s       @still                  ; if 1 the STILL
            rts

@still      move.l      a1,a2                   ; caddr=baddr

            STILL       #4,d5,d3

            XVAL0       (a2),d3,a0,d6,d7,d0
            addq.l      #4,a2                   ; caddr+=x_blk
            XVAL0       (a2),d3,a0,d6,d7,d0
            adda.w      d5,a2                   ; caddr+=y_blk
            XVAL0       (a2),d3,a0,d6,d7,d0
            addq.l      #4,a2                   ; caddr+=x_blk
            XVAL0       (a2),d3,a0,d6,d7,d0

            bsr         STILLSKIP
            rts

            ENDFUNC

DOSEND0     FUNC    EXPORT

            buf_rinc    a0,d6,d7                ; BUF_INC
            buf_get     d6,d7                   ; BUF_GET
            bne.s       @cont                   ; if 1 then continue
            rts

@cont       move.l      a1,a2                   ; caddr=baddr
            buf_get     d6,d7                   ; BUF_GET
            beq.w       @ss                     ; if 0 then STILLSEND
            buf_get     d6,d7                   ; BUF_GET
            beq.w       @vd                     ; if 0 then VOID

            SEND        #4,d5,d3

            XDELTA      (a2),d3,a0,d6,d7,d0
            addq.l      #4,a2                   ; caddr+=x_blk
            XDELTA      (a2),d3,a0,d6,d7,d0
            adda.w      d5,a2                   ; caddr+=y_blk
            XDELTA      (a2),d3,a0,d6,d7,d0
            addq.l      #4,a2                   ; caddr+=x_blk
            XDELTA      (a2),d3,a0,d6,d7,d0

            bsr         SENDSKIP
            rts

@ss         ;STILLSEND  #4,d5,d3

            XVAL1       (a2),d3,a0,d6,d7,d0
            addq.l      #4,a2                   ; caddr+=x_blk
            XVAL1       (a2),d3,a0,d6,d7,d0
            adda.w      d5,a2                   ; caddr+=y_blk
            XVAL1       (a2),d3,a0,d6,d7,d0
            addq.l      #4,a2                   ; caddr+=x_blk
            XVAL1       (a2),d3,a0,d6,d7,d0

            bsr         SS_SKIP
            rts

@vd         ;VOID       #4,d5
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
        clr.w       (a2)
        addq.l      #4,a2               ; caddr+=x_blk
        clr.w       (a2)
        adda.w      d5,a2               ; caddr+=y_blk
        clr.w       (a2)
        addq.l      #4,a2               ; caddr+=x_blk
        clr.w       (a2)
        rts
*
        ENDFUNC

        macro
        DOSTILL1    &addr
*
        buf_get     d6,d7                ; BUF_GET
        beq.w       @next                ; if 0 the STOP

        move.l      a1,a2                ; caddr=baddr
        add.l       &addr,a2             ; caddr+=addrs[1]
        STILL       #4,d5,d4
        bsr         STILLSKIP
        buf_rinc    a0,d6,d7             ; BUF_INC
@next
*
        endm

        macro
        DOVOID1     &addr
*
        move.l      a1,a2                ; caddr=baddr
        add.l       &addr,a2             ; caddr+=addrs[1]
        VOID        #4,d5
*
        endm

        macro
        DOSTILLSEND1    &addr
*
        buf_get     d6,d7                ; BUF_GET
        beq.w       @next                ; if 0 the STOP
        move.l      a1,a2                ; caddr=baddr
        add.l       &addr,a2             ; caddr+=addrs[1]
        buf_get     d6,d7                ; BUF_GET
        beq.s       @ss                  ; if 0 then STILLSEND

        VOID        #4,d5
        bra         @next

@ss     STILLSEND   #4,d5,d4
        bsr         SS_SKIP
        buf_rinc    a0,d6,d7             ; BUF_INC
@next
*
        endm

DOSTILL2    FUNC    EXPORT
*
        buf_rinc    a0,d6,d7             ; BUF_INC
        buf_get     d6,d7                ; BUF_GET
        bne.s       @cont                ; if 1 the CONT
        rts

@cont   move.l      a1,a2                ; caddr=baddr
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
            add.l       (a3),a2                 ; caddr+=addrs[0]
            STILL       #8,d5,d3

            swap        d5
            exg         d4,a5

            buf_rinc    a0,d6,d7                ; BUF_INC
            DOSTILL1    4(a3)
            DOSTILL1    8(a3)
            DOSTILL1    12(a3)
            DOSTILL1    16(a3)

            swap        d5
            exg         d4,a5
            rts

            macro
            DOSEND1     &addr

            buf_get     d6,d7                   ; BUF_GET
            beq.w       @next                   ; if 0 the STOP
            move.l      a1,a2                   ; caddr=baddr
            add.l       &addr,a2                ; caddr+=addrs[1]
            buf_get     d6,d7                   ; BUF_GET
            beq.w       @ss                     ; if 0 then STILLSEND
            buf_get     d6,d7                   ; BUF_GET
            beq.w       @vd                     ; if 0 then VOID

            SEND        #4,d5,d4
            bsr         SENDSKIP
            bra         @rinc

@vd         VOID        #4,d5
            bra         @next

@ss         STILLSEND   #4,d5,d4
            bsr         SS_SKIP
@rinc       buf_rinc    a0,d6,d7                ; BUF_INC
@next

            endm

DOSEND2     FUNC    EXPORT

            buf_rinc    a0,d6,d7                ; BUF_INC
            buf_get     d6,d7                   ; BUF_GET
            bne.s       @cont                   ; if 1 the CONT
@nxt        rts

@cont       move.l      a1,a2                   ; caddr=baddr
            add.l       (a3),a2                 ; caddr+=addrs[0]
            buf_get     d6,d7                   ; BUF_GET
            beq.w       @ss                     ; if 0 then STILLSEND
            buf_get     d6,d7                   ; BUF_GET
            beq.w       @vd                     ; if 0 then VOID

*** SEND ***

            SEND        #8,d1,d3

            buf_rinc    a0,d6,d7                ; BUF_INC
            DOSEND1     4(a3)
            DOSEND1     8(a3)
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
        DOSEND1     12(a3)
        DOSEND1     16(a3)
        rts

*** STILLSEND ***

?ss     STILLSEND   #8,d1,d3

        buf_rinc    a0,d6,d7            ; BUF_INC
        DOSTILLSEND1    4(a3)
        DOSTILLSEND1    8(a3)
        DOSTILLSEND1    12(a3)
        DOSTILLSEND1    16(a3)
        rts

*** VOID ***

?vd     VOID        #8,d1

        DOVOID1     4(a3)
        DOVOID1     8(a3)
        DOVOID1     12(a3)
        DOVOID1     16(a3)
        rts
*
        ENDFUNC

        macro
        UVSTILL0
*
*   Low_Pass
*
        move.l      a1,a2               ; caddr=baddr
        LPFSTILL    #4,d5,d2,d4
*
*   Sub-band gh
*
        addq.l      #2,a1               ; baddr+=2 (gh band)
        bsr         DOSTILL0
*
*   Sub-band hg
*
        subq.l      #2,a1               ; baddr-=2 (hh band)
        add.l       a4,a1               ; caddr+=1 row (hg band)
        bsr         DOSTILL0
*
*   Sub-band gg
*
        addq.l      #2,a1               ; baddr+=2 (gg band)
        bsr         DOSTILL0
        sub.l       a4,a1               ; caddr-=1 row (gh band)
        addq.l      #6,a1               ; (2+) addr[0]+=x_inc
*
        endm

        macro
        UVSEND0
*
*   Low_Pass
*
        buf_rinc    a0,d6,d7            ; BUF_INC
        buf_get     d6,d7               ; BUF_GET
        beq.w       0subs               ; if 0 then process subbands
```

```
                    Engineering:KlicsCode:CompPict:KlicsDec2.a

        move.l =    a1,a2                   ; caddr=baddr
        SEND        #4,d5,d2
*
*   Sub-band gh
*
@subs   addq.l      #2,a1                   ; baddr+=2 (gh band)
        bsr         DOSEND0
*
*   Sub-band hg
*
        subq.l      #2,a1                   ; baddr-=2 (hh band)
        add.l       a4,a1                   ; caddr+=1 row (hg band)
        bsr         DOSEND0
*
*   Sub-band gg
*
        addq.l      #2,a1                   ; baddr+=2 (gg band)
        bsr         DOSEND0
        sub.l       a4,a1                   ; caddr-=1 row (gh band)
        addq.l      #6,a1                   ; (2+) addr[0]-=x_inc
*
        endm

*********************************
*
*   Decoder functions:
*
*   Klics2D1Still, Klics2D1Send
*
*********************************

Klics2D1Still   FUNC    EXPORT
*
*   Klics2D1Still(short *dst, long size_x, long size_y, long lpfbits, short *norms
*
PS      RECORD      8
dst     DS.L        1
size_x  DS.L        1
size_y  DS.L        1
lpfbits DS.L        1
norms   DS.L        1
ptr     DS.L        1
data    DS.L        1
bno     DS.L        1
        ENDR
*
LS      RECORD      0,DECR
x_lim   DS.L        1                   ; x counter termination     row_start+
x_linc  DS.L        1                   ; x termination increment   1 row
y_inc0  DS.L        1                   ; y counter increment       4 rows
y_inc1  DS.L        1                   ; y counter increment       7 rows
y_lim   DS.L        1                   ; y counter termination     area
LSize   EQU         *
        ENDR
*
*   d0/d1 - spare
*   d2 - step 0 (HH)
*   d3 - step 0
*   d4 - lpfbits
*   d5 - y_blk
*   d6 - data   (bit stream)
*   d7 - bno    (bit pointer)
*
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
*   a0 - ptr    (bit buffer)
*   a1 - baddr  (block address)
*   a2 - caddr  (coeff address)
*   a3 - x_lim
*   a4 - x_linc
*   a5 - y_inc0
*
        link        a6,#LS.LSize            ; locals
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
*   Load Bit Buffer
*
        move.l      PS.data(a6),a0          ; a0=&data
        move.l      (a0),d6                 ; data=*a0
        move.l      PS.bno(a6),a0           ; a0=&mask
        move.l      (a0),d7                 ; mask=*a0
        move.l      PS.ptr(a6),a0           ; a0=&ptr
        move.l      (a0),a0                 ; a0=ptr
*
*   Set Up Block Counters
*
        move.l      PS.dst(a6),a1           ; a1=image
        move.l      PS.size_x(a6),d0        ; d0=size_x
        add.l       d0,d0                   ; in shorts
        move.l      d0,LS.x_linc(a6)        ; x_linc=1 row
        move.l      PS.size_y(a6),d1        ; d1=size_y
        muls.w      d0,d1                   ; d1*=d0 (area)
        add.l       a1,d1                   ; d1+=image
        move.l      d1,LS.y_lim(a6)         ; y_lim=d1
        move.l      d0,d2                   ; d2=d0 (1 row)
        add.l       d0,d0                   ; d0*=2 (2 rows)
        move.l      d0,d5                   ; y_blk=d0
        subq.l      #4,d5                   ; y_blk-=x_blk
        add.l       d0,d0                   ; d0*=2 (4 rows)
        move.l      d0,LS.y_inc0(a6)        ; y_inc0=d0
        add.l       d0,d0                   ; d0*=2 (8 rows)
        sub.l       d2,d0                   ; d0-=d2 (7 rows)
        move.l      d0,LS.y_inc1(a6)        ; y_inc1=d0

        move.l      PS.norms(a6),a2         ; GetNorm pointer
        move.l      (a2),d2                 ; read normal
        move.l      4(a2),d3                ; read normal
        move.l      PS.lpfbits(a6),d4       ; read lpfbits
        move.l      LS.x_linc(a6),a4        ; read x_linc
        move.l      LS.y_inc0(a6),a5        ; read y_inc0

@y      move.l      a4,a3                   ; x_lim=x_linc
        add.l       a1,a3                   ; x_lim+=baddr
@x      UVSTILL0                            ; process UV block 0,0
        UVSTILL0                            ; process UV block 1,0
        add.l       a5,a1                   ; (2) addr[0]+=y_inc
        cmp.l       LS.y_lim(a6),a1         ; (2+) addr[0]-limit?
        bge.w       @last                   ; if half height
        sub.l       #16,a1                  ; pointer=blk(0,1)
        UVSTILL0                            ; process UV block 0,1
        UVSTILL0                            ; process UV block 1,1
@last   sub.l       a5,a1                   ; (2) addr[0]+=y_inc

        cmp.l       a3,a1                   ; (2+) addr[0]-limit?
        blt.w       @x                      ; (4) if less then loopX
        add.l       LS.y_inc1(a6),a1        ; (2+) addr[0]+=y_inc
        cmp.l       LS.y_lim(a6),a1         ; (2+) addr[0]-limit?
        blt.w       @y                      ; (4) if less then loopY
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
*
*   Save Bit Buffer
*
        move.l      PS.data(a6),a2          ; spare=&data
        move.l      d6,(a2)                 ; update data
        move.l      PS.bno(a6),a2           ; spare=&bno
        move.l      d7,(a2)                 ; update bno
        move.l      PS.ptr(a6),a2           ; spare=&ptr
        move.l      a0,(a2)                 ; update ptr
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-----------------------------------------
Klics2D1Send    FUNC    EXPORT
*
*   Klics2D1Send(short *dst, long size_x, long size_y, short *norms, unsigned long
*
PS      RECORD      8
dst     DS.L        1
size_x  DS.L        1
size_y  DS.L        1
norms   DS.L        1
ptr     DS.L        1
data    DS.L        1
bno     DS.L        1
        ENDR
*
LS      RECORD      0,DECR
x_lim   DS.L        1                   ; x counter termination     row_start+
x_linc  DS.L        1                   ; x termination increment   1 row
y_inc0  DS.L        1                   ; y counter increment       4 rows
y_inc1  DS.L        1                   ; y counter increment       7 rows
y_lim   DS.L        1                   ; y counter termination     area
LSize   EQU         *
        ENDR
*
*   d0/d1 - spare
*   d2 - step 0 (HH)
*   d3 - step 0
*   d4 - y_inc0
*   d5 - y_blk
*   d6 - data   (bit stream)
*   d7 - bno    (bit pointer)
*
*   a0 - ptr    (bit buffer)
*   a1 - baddr  (block address)
*   a2 - caddr  (coeff address)
*   a3 - x_lim
*   a4 - x_linc
*   a5 - y_lim
*
        link        a6,#LS.LSize            ; locals
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
*   Load Bit Buffer
*
        move.l      PS.data(a6),a0          ; a0=&data
        move.l      (a0),d6                 ; data=*a0
        move.l      PS.bno(a6),a0           ; a0=&mask
        move.l      (a0),d7                 ; mask=*a0
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
        move.l      PS.ptr(a6),a0          ; a0=&ptr
        move.l      (a0),a0                ; a0=ptr
*
*   Set Up Block Counters
*
        move.l      PS.dst(a6),a1          ; a1=image
        move.l      PS.size_x(a6),d0       ; d0=size_x
        add.l       d0,d0                  ; in shorts
        move.l      d0,LS.x_linc(a6)       ; x_linc=1 row
        move.l      PS.size_y(a6),d1       ; d1=size_y
        muls.w      d0,d1                  ; d1*=d0 (area)
        add.l       a1,d1                  ; d1+=image
        move.l      d1,LS.y_lim(a6)        ; y_lim=d1
        move.l      d0,d2                  ; d2=d0 (1 row)
        add.l       d0,d0                  ; d0*=2 (2 rows)
        move.l      d0,d5                  ; copy to d5
        subq.l      #4,d5                  ; subtract x_blk
        add.l       d0,d0                  ; d0*=2 (4 rows)
        move.l      d0,LS.y_inc0(a6)       ; y_inc0=d0
        add.l       d0,d0                  ; d0*=2 (8 rows)
        sub.l       d2,d0                  ; d0-=d2 (7 rows)
        move.l      d0,LS.y_inc1(a6)       ; y_inc1=d0

        move.l      PS.norms(a6),a2        ; GetNorm pointer
        move.l      (a2),d2                ; read normal
        move.l      4(a2),d3               ; read normal
        move.l      LS.x_linc(a6),a4       ; read x_linc
        move.l      LS.y_inc0(a6),d4       ; read y_inc0
        move.l      LS.y_lim(a6),a5        ; read y_lim

@y      move.l      a4,a3                  ; x_lim=x_linc
        add.l       a1,a3                  ; x_lim+=baddr
@x      UVSEND0                            ; process UV block 0,0
        UVSEND0                            ; process UV block 1,0
        add.l       d4,a1                  ; (2) addr[0]+=y_inc
        cmp.l       a5,a1                  ; (2) addr[0]-limit?
        bge.w       @last                  ; if half height
        sub.l       #16,a1                 ; pointer=blk(0,1)
        UVSEND0                            ; process UV block 0,1
        UVSEND0                            ; process UV block 1,1
@last   sub.l       d4,a1                  ; (2) addr[0]+=y_inc

        cmp.l       a3,a1                  ; (2) addr[0]-limit?
        blt.w       @x                     ; (4) if less then loopX
        add.l       LS.y_inc1(a6),a1       ; (2+) addr[0]+=y_inc
        cmp.l       a5,a1                  ; (2) addr[0]-limit?
        blt.w       @y                     ; (4) if less then loopY
*
*   Save Bit Buffer
*
        move.l      PS.data(a6),a2         ; spare=&data
        move.l      d6,(a2)                ; update data
        move.l      PS.bno(a6),a2          ; spare=&bno
        move.l      d7,(a2)                ; update bno
        move.l      PS.ptr(a6),a2          ; spare=&ptr
        move.l      a0,(a2)                ; update ptr
*
        movem.l     (a7)+,d4-d7/a3-a5      ; restore registers
        unlk        a6                     ; remove locals
        rts                                ; return
*
        ENDFUNC
*-----------------------------------
```

```
                    Engineering:KlicsCode:CompPict:KlicsDec2.a

Klics3D2Still  FUNC    EXPORT
*
*   Klics3D2Still(short *dst, long size_x, long size_y, long lpfbits, short *norms
*
PS      RECORD      8
dst     DS.L        1
size_x  DS.L        1
size_y  DS.L        1
lpfbits DS.L        1
norms   DS.L        1
ptr     DS.L        1
data    DS.L        1
bno     DS.L        1
sub_tab DS.L        1
        ENDR
*
LS      RECORD      0,DECR
y_blk0  DS.L        1                   ; y inter-block increment   2 rows - 4
y_blk1  DS.L        1                   ; y inter-block increment   4 rows - 8
x_inc   DS.L        1                   ; x counter increment       16
x_lim   DS.L        1                   ; x counter termination     row_start+
x_linc  DS.L        1                   ; x termination increment   1 row
y_inc   DS.L        1                   ; y counter increment       7 rows
y_lim   DS.L        1                   ; y counter termination     area
LSize   EQU         *
        ENDR
*
*   d0/d1 - spare
*   d2 - step 2HH
*   d3 - step 1
*   d4 - step 0/lpfbits
*   d5 - y_blk0,y_blk1
*   d6 - data   (bit stream)
*   d7 - bno    (bit pointer)
*
*   a0 - ptr    (bit buffer)
*   a1 - baddr  (block address)
*   a2 - caddr  (coeff address)
*   a3 - addrs  (tree addresses)
*   a4 - x_lim  (x counter termination)
*   a5 - lpfbits/step 0
*
        link        a6,#LS.LSize            ; locals
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
*   Load Bit Buffer
*
        move.l      PS.data(a6),a0          ; a0=&data
        move.l      (a0),d6                 ; data=*a0
        move.l      PS.bno(a6),a0           ; a0=&mask
        move.l      (a0),d7                 ; mask=*a0
        move.l      PS.ptr(a6),a0           ; a0=&ptr
        move.l      (a0),a0                 ; a0=ptr
*
*   Set Up Block Counters
*
        move.l      PS.dst(a6),a1           ; a1=image
        move.l      PS.size_x(a6),d0        ; d0=size_x
        move.l      #16,LS.x_inc(a6)        ; save x_inc
        add.l       d0,d0                   ; in shorts
        move.l      d0,LS.x_linc(a6)        ; x_linc=1 row
        move.l      PS.size_y(a6),d1        ; d1=size_y
        muls.w      d0,d1                   ; d1*=d0 (area)
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
            add.l       a1,d1                   ; d1+=image
            move.l      d1,LS.y_lim(a6)         ; y_lim=d1
            move.l      d0,d2                   ; d2=d0 (1 row)
            add.l       d0,d0                   ; d0*=2 (2 rows)
            move.l      d0,d5                   ; copy to d5
            subq.l      #4,d5                   ; y_blk: subtract x_blk
            move.l      d5,LS.y_blk0(a6)        ; save y_blk0
            add.l       d0,d2                   ; d2+=d0 (3 rows)
            add.l       d0,d0                   ; d0*=2  (4 rows)
            move.l      d0,d4                   ; copy to d5
            subq.l      #8,d4                   ; y_blk: subtract x_blk
            move.l      d4,LS.y_blk1(a6)        ; save y_blk1
            add.l       d2,d0                   ; d0+=d2 (7 rows)
            move.l      d0,LS.y_inc(a6)         ; y_inc=d0

            move.l      PS.norms(a6),a2         ; GetNorm pointer
            move.l      (a2),d2                 ; read normal
            move.l      4(a2),d3                ; read normal 1
            move.l      8(a2),a5                ; read normal 0
            move.l      PS.lpfbits(a6),d4       ; read lpfbits
            swap        d5                      ; y_blk=00XX
            move.l      LS.y_blk1(a6),d0        ; read y_blk1
            move.w      d0,d5                   ; d5=y_blk0/1
            move.l      PS.sub_tab(a6),a3       ; a3=addrs

@y          move.l      LS.x_linc(a6),a4        ; x_lim=x_linc
            add.l       a1,a4                   ; x_lim+=baddr
*
*   Low_Pass
*
@x          move.l      a1,a2                   ; caddr=baddr
            LPFSTILL    #8,d5,d2,d4
*
*   Sub-band gh
*
            bsr         DOSTILL2
            add.l       #20,a3
*
*   Sub-band hg
*
            bsr         DOSTILL2
            add.l       #20,a3
*
*   Sub-band gg
*
            bsr         DOSTILL2
            sub.l       #40,a3

            add.l       #16,a1                  ; (2) addr[0]+=x_inc
            cmp.l       a4,a1                   ; (2) addr[0]-limit?
            blt.w       @x                      ; (4) if less then loopX
            add.l       LS.y_inc(a6),a1         ; (2+) addr[0]+=y_inc
            cmp.l       LS.y_lim(a6),a1         ; (2+) addr[0]-limit?
            blt.w       @y                      ; (4) if less then loopY
*
*   Save Bit Buffer
*
@end        move.l      PS.data(a6),a2          ; spare=&data
            move.l      d6,(a2)                 ; update data
            move.l      PS.bno(a6),a2           ; spare=&bno
            move.l      d7,(a2)                 ; update bno
            move.l      PS.ptr(a6),a2           ; spare=&ptr
            move.l      a0,(a2)                 ; update ptr
```

```
*
        movem.l     (a7)+,d4-d7/a3-a5        ; restore registers
        unlk        a6                       ; remove locals
        rts                                  ; return
*
        ENDFUNC
*---------------------------------
Klics3D2Send    FUNC    EXPORT
*
*   Klics3D2Send(short *dst, long size_x, long size_y, short *norms, unsigned long
*
PS      RECORD      8
dst     DS.L        1
size_x  DS.L        1
size_y  DS.L        1
norms   DS.L        1
ptr     DS.L        1
data    DS.L        1
bno     DS.L        1
sub_tab DS.L        1
        ENDR
*
LS      RECORD      0,DECR
y_blk0  DS.L        1                        ; y inter-block increment   2 rows - 4
y_blk1  DS.L        1                        ; y inter-block increment   4 rows - 8
x_inc   DS.L        1                        ; x counter increment       16
x_lim   DS.L        1                        ; x counter termination     row_start+
x_linc  DS.L        1                        ; x termination increment   1 row
y_inc   DS.L        1                        ; y counter increment       7 rows
y_lim   DS.L        1                        ; y counter termination     area
LSize   EQU         *
        ENDR
*
*   d0 - spare
*   d1 - y_blk1
*   d2 - step 2HH
*   d3 - step 1
*   d4 - step 0
*   d5 - y_blk0
*   d6 - data    (bit stream)
*   d7 - bno     (bit pointer)
*
*   a0 - ptr     (bit buffer)
*   a1 - baddr   (block address)
*   a2 - caddr   (coeff address)
*   a3 - addrs   (tree addresses)
*   a4 - x_lim   (x counter termination)
*
        link        a6,#LS.LSize             ; locals
        movem.l     d4-d7/a3-a5,-(a7)        ; store registers
*
*   Load Bit Buffer
*
        move.l      PS.data(a6),a0           ; a0=&data
        move.l      (a0),d6                  ; data=*a0
        move.l      PS.bno(a6),a0            ; a0=&mask
        move.l      (a0),d7                  ; mask=*a0
        move.l      PS.ptr(a6),a0            ; a0=&ptr
        move.l      (a0),a0                  ; a0=ptr
*
*   Set Up Block Counters
*
        move.l      PS.dst(a6),a1            ; a1=image
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
            move.l      PS.size_x(a6),d0        ; d0=size_x
            move.l      #16,LS.x_inc(a6)        ; save x_inc
            add.l       d0,d0                   ; in shorts
            move.l      d0,LS.x_linc(a6)        ; x_linc=1 row
            move.l      PS.size_y(a6),d1        ; d1=size_y
            muls.w      d0,d1                   ; d1*=d0 (area)
            add.l       a1,d1                   ; d1+=image
            move.l      d1,LS.y_lim(a6)         ; y_lim=d1
            move.l      d0,d2                   ; d2=d0 (1 row)
            add.l       d0,d0                   ; d0*=2 (2 rows)
            move.l      d0,d5                   ; copy to d5
            subq.l      #4,d5                   ; y_blk: subtract x_blk
            move.l      d5,LS.y_blk0(a6)        ; save y_blk0
            add.l       d0,d2                   ; d2+=d0 (3 rows)
            add.l       d0,d0                   ; d0*=2  (4 rows)
            move.l      d0,d4                   ; copy to d5
            subq.l      #8,d4                   ; y_blk: subtract x_blk
            move.l      d4,LS.y_blk1(a6)        ; save y_blk1
            add.l       d2,d0                   ; d0+=d2 (7 rows)
            move.l      d0,LS.y_inc(a6)         ; y_inc=d0

            move.l      PS.norms(a6),a2         ; GetNorm pointer
            move.l      (a2),d2                 ; read normal
            move.l      4(a2),d3                ; read normal 1
            move.l      8(a2),d4                ; read normal 0
            move.l      LS.y_blk1(a6),d1        ; read y_blk1
            move.l      PS.sub_tab(a6),a3       ; a3=addrs

@y          move.l      LS.x_linc(a6),a4        ; x_lim=x_linc
            add.l       a1,a4                   ; x_lim+=baddr
*
*   Low_Pass
*
@x          buf_rinc    a0,d6,d7                ; BUF_INC
            buf_get     d6,d7                   ; BUF_GET
            beq.w       @subs                   ; if 0 then process subbands
            move.l      a1,a2                   ; caddr=baddr
            SEND        #8,d1,d2
*
*   Sub-band gh
*
@subs       bsr         DOSEND2
            add.l       #20,a3
*
*   Sub-band hg
*
            bsr         DOSEND2
            add.l       #20,a3
*
*   Sub-band gg
*
            bsr         DOSEND2
            sub.l       #40,a3

            add.l       #16,a1                  ; (2) addr[0]+=x_inc
            cmp.l       a4,a1                   ; (2) addr[0]-limit?
            blt.w       @x                      ; (4) if less then loopX
            add.l       LS.y_inc(a6),a1         ; (2+) addr[0]+=y_inc
            cmp.l       LS.y_lim(a6),a1         ; (2+) addr[0]-limit?
            blt.w       @y                      ; (4) if less then loopY
*
*   Save Bit Buffer
*
```

Engineering:KlicsCode:CompPict:KlicsDec2.a

```
;end    move.l      PS.data(a6),a2          ; spare=&data
        move.l      d6,(a2)                 ; update data
        move.l      PS.bno(a6),a2           ; spare=&bno
        move.l      d7,(a2)                 ; update bno
        move.l      PS.ptr(a6),a2           ; spare=&ptr
        move.l      a0,(a2)                 ; update ptr
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-----------------------------------
        END
```

Engineering:KlicsCode:CompPict:KlicsDec.c

```
/*************************************
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 *************************************/
/*
 *  Importing raw Klics binary files
 *
 *  Stand-alone version
 */

#include    "Bits3.h"
#include    "Klics.h"
#include    "KlicsHeader.h"

typedef char    Boolean;

/* If bool true the negate value */
#define negif(bool,value)   ((bool)?-(value):(value))

extern  void    HaarBackward();
extern  void    Daub4Backward(short *data,int size[2],int oct_src);
extern  void    TestTopBackward(short *data,int size[2],int oct_src);
extern  void    TestBackward(short *data,int size[2],int oct_src);
extern  void    KLICSDCHANNEL(short *dst, long octs, long size_x, long size_y, lon
/* Use the bit level file macros (Bits2.h) */
/* buf_use; */

/* Huffman decode a block */
#define HuffDecLev(lev,buf) \
    lev[0]=HuffDecode(buf); \
    lev[1]=HuffDecode(buf); \
    lev[2]=HuffDecode(buf); \
    lev[3]=HuffDecode(buf);

/* Fixed length decode block of integers */
#define IntDecLev(lev,lpf_bits,buf) \
    lev[0]=IntDecode(lpf_bits,buf); \
    lev[1]=IntDecode(lpf_bits,buf); \
    lev[2]=IntDecode(lpf_bits,buf); \
    lev[3]=IntDecode(lpf_bits,buf);

/* Reverse quantize difference block */
#define RevQntDelta(new,old,lev,shift) \
    new[0]=old[0]+(lev[0]<<shift)+(lev[0]!=0?negif(lev[0]<0,(1<<shift)-1>>1):0); \
    new[1]=old[1]+(lev[1]<<shift)+(lev[1]!=0?negif(lev[1]<0,(1<<shift)-1>>1):0); \
    new[2]=old[2]+(lev[2]<<shift)+(lev[2]!=0?negif(lev[2]<0,(1<<shift)-1>>1):0); \
    new[3]=old[3]+(lev[3]<<shift)+(lev[3]!=0?negif(lev[3]<0,(1<<shift)-1>>1):0);

/* Reverse quantize block */
#define RevQnt(new,lev,shift) \
    new[0]=(lev[0]<<shift)+(lev[0]!=0?negif(lev[0]<0,(1<<shift)-1>>1):0); \
    new[1]=(lev[1]<<shift)+(lev[1]!=0?negif(lev[1]<0,(1<<shift)-1>>1):0); \
    new[2]=(lev[2]<<shift)+(lev[2]!=0?negif(lev[2]<0,(1<<shift)-1>>1):0); \
    new[3]=(lev[3]<<shift)+(lev[3]!=0?negif(lev[3]<0,(1<<shift)-1>>1):0);

#define RevQntLPF(new,lev,shift) \
    new[0]=(lev[0]<<shift)+((1<<shift)-1>>1); \
    new[1]=(lev[1]<<shift)+((1<<shift)-1>>1); \
    new[2]=(lev[2]<<shift)+((1<<shift)-1>>1); \
```

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```
    new[3]=lev[3]<<shift)+((1<<shift.-1>>1);

/* Read a difference block and update memory */
#define DoXferDelta(addr,old,new,lev,dst,shift,mode,oct,nmode,buf) \
    HuffDecLev(lev,buf); \
    RevQntDelta(new,old,lev,shift) \
    PutData(addr,new,dst); \
    mode[oct]=oct==0?M_STOP:nmode;

/* Read a block and update memory */
#define DoXfer(addr,new,lev,dst,shift,mode,oct,nmode,buf) \
    HuffDecLev(lev,buf); \
    RevQnt(new,lev,shift) \
    PutData(addr,new,dst); \
    mode[oct]=oct==0?M_STOP:nmode;

/*  Function Name:  IntDecode
 *  Description:    Read a integer from bit file
 *  Arguments:  bits - bits/integer now signed
 *  Returns:    integer value
 */

short   IntDecode(short bits,Buf buf)
{
    int     i, lev=0, mask=1;
    Boolean sign;

    /* Hardware compatatble version */
    buf_rinc(buf);
    sign=buf_get(buf);
    for(i=0;i<bits-1;i++) {
        buf_rinc(buf);
        if (buf_get(buf)) lev |= mask;
        mask <<= 1;
    }
    if (sign) lev= -lev;
    return(lev);
}

/*  Function Name:  HuffDecode
 *  Description:    Read a Huffman coded integer from bit file
 *  Returns:    integer value
 */

short   HuffDecode(Buf buf)

{
    short   lev=0, i;
    Boolean neg;

    /* Hardware compatatble version */
    buf_rinc(buf);
    if (buf_get(buf)) {
        buf_rinc(buf);
        neg=buf_get(buf);
        do {
            buf_rinc(buf);
            lev++;
        } while (lev<7 && !(buf_get(buf)));
        if (!(buf_get(buf))) {
            for(lev=0,i=0;i<7;i++) {
                lev<<=1;
                buf_rinc(buf);
```

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```
            =  if (buf_get(buf)) lev++;
            }
            lev+=8;
        }
        if (neg) lev= -lev;
    }
    return(lev);
}

/*  Function Name:  KlicsDChannel
 *  Description:    Decode a channel of image
 *  Arguments:  dst - destination memory (and old for videos)
 *              octs, size - octaves of decomposition and image dimensions
 *              normals - HVS weighted normals
 *              lpf_bits - no of bits for LPF integer (image coding only)
 */

void    KlicsDecY(short *dst, int octs, int size[2], KlicsFrameHeader *frmh,
    KlicsSeqHeader *seqh, Buf buf)
{
    int     oct, mask, x, y, sub, step=2<<octs, blk[4], mode[4], base_mode=(frmh->
    Blk     addr, new, old, lev;

    for(y=0;y<size[1];y+=step)
    for(x=0;x<size[0];x+=step)
    for(sub=0;sub<4;sub++) {
    mode[oct=octs-1]=base_mode;
    if (sub==0) mode[oct=octs-1] |= M_LPF;
    mask=2<<oct;
    do {
        GetAddr(addr,x,y,sub,oct,size,mask);
        switch(mode[oct]) {
        case M_VOID:
            GetData(addr,old,dst);
            if (BlkZero(old)) mode[oct]=M_STOP;
            else { DoZero(addr,dst,mode,oct); }
            break;
        case M_SEND|M_STILL:
            buf_rinc(buf);
            if (buf_get(buf)) {
                buf_rinc(buf);
                if (buf_get(buf)) {
                    DoZero(addr,dst,mode,oct);
                } else {
                    DoXfer(addr,new,lev,dst,frmh->quantizer[octs-oct],mode,oct,M_S
                }
            } else
                mode[oct]=M_STOP;
            break;
        case M_SEND:
            buf_rinc(buf);
            if (buf_get(buf)) {
                buf_rinc(buf);
                if (buf_get(buf)) {
                    buf_rinc(buf);
                    if (buf_get(buf)) {
                        GetData(addr,old,dst);
                        DoXferDelta(addr,old,new,lev,dst,frmh->quantizer[octs-oct]
                    } else {
                        DoZero(addr,dst,mode,oct);
                    }
                } else {
                    DoXfer(addr,new,lev,dst,frmh->quantizer[octs-oct],mode,oct,M_S
```

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```
            }
        } else
            mode[oct]=M_STOP;
        break;
    case M_STILL:
        buf_rinc(buf);
        if (buf_get(buf)) { DoXfer(addr,new,lev,dst,frmh->quantizer[octs-oct],
        else mode[oct]=M_STOP;
        break;
    case M_LPF|M_STILL:
        IntDecLev(lev,seqh->precision-frmh->quantizer[0],buf);
        RevQntLPF(new,lev,frmh->quantizer[0]);
        PutData(addr,new,dst);
        mode[oct]=M_QUIT;
        break;
    case M_LPF|M_SEND:
        buf_rinc(buf);
        if (buf_get(buf)) {
            GetData(addr,old,dst);
            HuffDecLev(lev,buf);
            RevQntDelta(new,old,lev,frmh->quantizer[0]);
            PutData(addr,new,dst);
        }
        mode[oct]=M_QUIT;
        break;
    }
    switch(mode[oct]) {
    case M_STOP:
        StopCounters(mode,oct,mask,blk,x,y,octs);
        break;
    case M_QUIT:
        break;
    default:
        DownCounters(mode,oct,mask,blk);
        break;
    }
} while (mode[oct]!=M_QUIT);
}
}

void    KlicsDecUV(short *dst, int octs, int size[2], KlicsFrameHeader *frmh,
    KlicsSeqHeader *seqh, Buf buf)
{
    int     oct, mask, x, y, X, Y, sub, step=4<<octs, blk[4], mode[4], base_mode=
    Blk     addr, new, old, lev;

    for(Y=0;Y<size[1];Y+=step)
    for(X=0;X<size[0];X+=step)
    for(y=Y;y<size[1] && y<Y+step;y+=step>>1)
    for(x=X;x<size[0] && x<X+step;x+=step>>1)
    for(sub=0;sub<4;sub++) {
    mode[oct=octs-1]=base_mode;
    if (sub==0) mode[oct=octs-1] |= M_LPF;
    mask=2<<oct;
    do {
        GetAddr(addr,x,y,sub,oct,size,mask);
        switch(mode[oct]) {
        case M_VOID:
            GetData(addr,old,dst);
            if (Blk2zero(old)) mode[oct]=M_STOP;
            else { DoZero(addr,dst,mode,oct); }
            break;
        case M_SEND|M_STILL:
```

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```
        buf_rinc(buf);
        if (buf_get(buf)) {
            buf_rinc(buf);
            if (buf_get(buf)) {
                DoZero(addr,dst,mode,oct);
            } else {
                DoXfer(addr,new,lev,dst,frmh->quantizer[octs-oct],mode,oct,M_S
            }
        } else
            mode[oct]=M_STOP;
        break;
    case M_SEND:
        buf_rinc(buf);
        if (buf_get(buf)) {
            buf_rinc(buf);
            if (buf_get(buf)) {
                buf_rinc(buf);
                if (buf_get(buf)) {
                    GetData(addr,old,dst);
                    DoXferDelta(addr,old,new,lev,dst,frmh->quantizer[octs-oct]
                } else {
                    DoZero(addr,dst,mode,oct);
                }
            } else {
                DoXfer(addr,new,lev,dst,frmh->quantizer[octs-oct],mode,oct,M_S
            }
        } else
            mode[oct]=M_STOP;
        break;
    case M_STILL:
        buf_rinc(buf);
        if (buf_get(buf)) { DoXfer(addr,new,lev,dst,frmh->quantizer[octs-oct],;
        else mode[oct]=M_STOP;
        break;
    case M_LPF|M_STILL:
        IntDecLev(lev,seqh->precision-frmh->quantizer[0],buf);
        RevQntLPF(new,lev,frmh->quantizer[0]);
        PutData(addr,new,dst);
        mode[oct]=M_QUIT;
        break;
    case M_LPF|M_SEND:
        buf_rinc(buf);
        if (buf_get(buf)) {
            GetData(addr,old,dst);
            HuffDecLev(lev,buf);
            RevQntDelta(new,old,lev,frmh->quantizer[0]);
            PutData(addr,new,dst);
        }
        mode[oct]=M_QUIT;
        break;
    }
    switch(mode[oct]) {
    case M_STOP:
        StopCounters(mode,oct,mask,blk,x,y,octs);
        break;
    case M_QUIT:
        break;
    default:
        DownCounters(mode,oct,mask,blk);
        break;
    }
} while (mode[oct]!=M_QUIT);
}
```

Engineering:KlicsCode:CompPict:KlicsDec.c

```
}

/*  Function Name:  KlicsDecode
 *  Description:    Decode a frame to YUV (de)transformed image
 *  Arguments:  src - destination result
 *              dst - transformed destination memory (and old for videos)
 *  Returns:    whether this frame was skipped
 */

extern  void    KLCOPY(short *dst, short *src, long area);
extern  void    KLHALF(short *dst, short *src, long size_0, long size_1);
extern  void    KLICS3D2SEND(short *dst, long size_x, long size_y, short norms[4][
extern  void    KLICS2D1STILL(short *dst, long size_x, long size_y, long lpfbits,
extern  void    KLICS3D2STILL(short *dst, long size_x, long size_y, long lpfbits,
extern  void    KLICS2D1SEND(short *dst, long size_x, long size_y, short norms[4][

#define flag_tree   0x1
#define flag_wave   0x2

void    KlicsDecode(short *src[3], short *dst[3], KlicsSeqHeader *seqh,KlicsFrameH
{
    long    channel,i;
    short   norms[4][2];
    unsigned long sync1, sync2;

    for(i=0;i<4;i++) {
        norms[i][0]=(1<<frmh->quantizer[i]-1)-1;
        norms[i][1]=frmh->quantizer[i];
    }
    buf_rinit(buf);
    if (0!=(flags&flag_tree)) {
        sync1=GetTimerValue(&sync1);
        for(channel=0;channel<seqh->channels;channel++) {
            int     size[2]={seqh->sequence_size[0]>>(channel==0?0:seqh->sub_sampl
                        seqh->sequence_size[1]>>(channel==0?0:seqh->sub_sample[1])
                    tree_size[2]={size[0]>>scale[0],size[1]>>scale[0]},
                    octs=seqh->octaves[channel==0?0:1];

#ifdef HQ
            if (0!=(frmh->flags&KFH_INTRA))
                KLZERO(dst[channel],tree_size[0]*tree_size[1]);
/*          KLICSDCHANNEL(dst[channel],octs-1,tree_size[0],tree_size[1],(long)(seq
            if (channel==0) KlicsDecY(dst[channel],octs,tree_size,frmh,seqh,buf);
            else KlicsDecUV(dst[channel],octs,tree_size,frmh,seqh,buf);
#else
            long    sub_tab[15]={4,2,10,2+8*tree_size[0],10+8*tree_size[0],
                        4*tree_size[0],2*tree_size[0],8+2*tree_size[0],10*tree_siz
                        4+4*tree_size[0],2+2*tree_size[0],10+2*tree_size[0],2+10*t

            if (0!=(frmh->flags&KFH_INTRA)) {
                KLZERO(dst[channel],tree_size[0]*tree_size[1]);
                if (octs==3)
                    KLICS3D2STILL(dst[channel],tree_size[0],tree_size[1],(long)(se
                else
                    KLICS2D1STILL(dst[channel],tree_size[0],tree_size[1],(long)(se
            } else
                if (octs==3)
                    KLICS3D2SEND(dst[channel],tree_size[0],tree_size[1],&norms,&bu
                else
                    KLICS2D1SEND(dst[channel],tree_size[0],tree_size[1],&norms,&bu
#endif
        }
        sync2=GetTimerValue(&sync2);
```

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```
        *tree=sync2-sync1;
    }
    if (0!=(flags&flag_wave)) {
        sync1=GetTimerValue(&sync1);
        for(channel=0;channel<seqh->channels;channel++) {
            int     size[2]={seqh->sequence_size[0]>>(channel==0?0:seqh->sub_sampl
                        seqh->sequence_size[1]>>(channel==0?0:seqh->sub_sample[1])
                    wave_size[2]={size[0]>>scale[1],size[1]>>scale[1]},
                    octs=seqh->octaves[channel==0?0:1];

            switch(seqh->wavelet) {
            case WT_Haar:
                if (scale[1]>scale[0])
                    KLHALF(dst[channel],src[channel],wave_size[0],wave_size[1]);
                else
                    KLCOPY(dst[channel],src[channel],wave_size[0]*wave_size[1]);
                HaarBackward(src[channel],wave_size,octs-scale[1]);
                break;
            case WT_Daub4:
                if (scale[0]==0) {
                    if (scale[1]>scale[0])
                        KLHALF(dst[channel],src[channel],wave_size[0],wave_size[1]
                    else
                        KLCOPY(dst[channel],src[channel],wave_size[0]*wave_size[1]
                    Daub4Backward(src[channel],wave_size,octs-scale[1]);
                } else
                    if (channel==0) {
                        KLCOPY(dst[channel],src[channel],wave_size[0]*wave_size[1]
                        Backward3511(src[channel],wave_size,octs-scale[1]);
                    } else
                        TOPBWD(dst[channel],src[channel],wave_size[0],wave_size[1]
                break;
            }
        }
        sync2=GetTimerValue(&sync2);
        *wave=sync2-sync1;
    }
}
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
/*********************************
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 *********************************/
/*
 *  Klics Codec
 */

#include "ImageCodec.h"
#include <FixMath.h>
#include <Errors.h>
#include <Packages.h>

#ifdef PERFORMANCE
    #include <Perf.h>
    extern  TP2PerfGlobals  ThePGlobals;
#endif

#ifdef DEBUG
    #define DebugMsg(val)   DebugStr(val)
#else
    #define DebugMsg(val)
#endif


#define WT_Haar  0
#define WT_Daub4 1

#define None    0
#define Use8    1
#define Use16   2
#define Use32   3
#define UseF32  4

/* Version information */

#define KLICS_CODEC_REV          1
#define codecInterfaceVersion    1   /* high word returned in component GetVersion

#define klicsCodecFormatName     "Klics"
#define klicsCodecFormatType     'klic'

pascal ComponentResult
KlicsCodec(ComponentParameters *params,char **storage);

pascal ComponentResult
KLOpenCodec(ComponentInstance self);

pascal ComponentResult
KLCloseCodec(Handle storage,ComponentInstance self);

pascal ComponentResult
KLCanDoSelector(short selector);

pascal ComponentResult
KLGetVersion();

pascal ComponentResult
KLGetCodecInfo(Handle storage,CodecInfo *info);
```

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```
pascal ComponentResult
KLGetMaxCompressionSize(Handle storage,PixMapHandle src,const Rect *srcRect,short
    CodecQ quality,long *size);

pascal ComponentResult
KLGetCompressedImageSize(Handle storage,ImageDescriptionHandle desc,Ptr data,long
    DataProcRecordPtr dataProc,long *size);

pascal ComponentResult
KLPreCompress(Handle storage,register CodecCompressParams *p);

pascal long
KLPreDecompress(Handle storage,register CodecDecompressParams *p);

pascal long
KLBandDecompress(Handle storage,register CodecDecompressParams *p);

pascal long
KLBandCompress(Handle storage,register CodecCompressParams *p);

pascal ComponentResult
KLGetCompressionTime(Handle storage,PixMapHandle src,const Rect *srcRect,short dep
        CodecQ *spatialQuality,CodecQ *temporalQuality,unsigned long *time);

/*  Function:   KlicsCodec
 *  Description:KlicsCodec main despatcher
 */

#ifdef DECODER
pascal ComponentResult
KlicsDecoder(ComponentParameters *params,char **storage)
#else
#ifdef ENCODER
pascal ComponentResult
KlicsEncoder(ComponentParameters *params,char **storage)
#else
pascal ComponentResult
KlicsCodec(ComponentParameters *params,char **storage)
#endif
#endif
{
    OSErr   err;

    switch ( params->what ) {
    case kComponentOpenSelect:
        err=CallComponentFunction(params,(ComponentFunction) KLOpenCodec); break;

    case    kComponentCloseSelect:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLC

    case    kComponentCanDoSelect:
        err=CallComponentFunction(params,(ComponentFunction)KLCanDoSelector); brea

    case kComponentVersionSelect :
        err=CallComponentFunction(params,(ComponentFunction)KLGetVersion); break;

#ifdef DECODER
    case codecPreCompress:
    case codecBandCompress:
        err=codecUnimpErr; break;
#else
    case codecPreCompress:
```

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```
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLP

    case codecBandCompress:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLB
#endif
#ifdef ENCODER
    case codecPreDecompress:
    case codecBandDecompress:
        err=codecUnimpErr; break;
#else
    case codecPreDecompress:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLP

    case codecBandDecompress:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLB
#endif
    case codecCDSequenceBusy:
        err=0; break;                   /* our codec is never asynchronously busy

    case codecGetCodecInfo:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLG

    case codecGetCompressedImageSize:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLG

    case codecGetMaxCompressionSize:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLG

    case codecGetCompressionTime:
        err=CallComponentFunctionWithStorage(storage,params,(ComponentFunction)KLG

    case codecGetSimilarity:
        err=codecUnimpErr; break;

    case codecTrimImage:
        err=codecUnimpErr; break;

    default:
        err=paramErr; break;
    }
    if (err!=noErr)
        DebugMsg("\pCodec Error");
    return(err);
}

#include <Memory.h>
#include <Resources.h>
#include <OSUtils.h>
#include <SysEqu.h>

#include <StdIO.h>
#include <Time.h>

#include <Strings.h>
#include <String.h>
#include "Bits3.h"
#include "KlicsHeader.h"
#include "KlicsEncode.h"

void    DebugString(char *string)
{
    DebugStr(string);
}
```

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```
extern  short   gResRef;

typedef struct {
    CodecInfo   **info;
    Ptr     tab[4];
    short   use[4];
} SharedGlobals;

typedef struct {
    KlicsERec   kle;                /* Encoding parameters */
    short   *src[3];                /* YUV Frame buffer */
    short   *dst[3];                /* YUV Frame buffer */
    Ptr     pixmap;                 /* Encoded pixmap data */
    long    size;                   /* Size of Previous Frame Buffer */
    long    using;                  /* Which lookup table are we using for colour
    long    scale[3];               /* Tree, Wave, Out scales 0=Original, -1=Doubl
    unsigned long prev_frame;       /* Previous frame number */
    unsigned long real_frame;       /* Previous real frame (no skips) */
    unsigned long dpy_frame;        /* Previous displayed frame */
    unsigned long run_frame;        /* First frame in play sequence */
    unsigned long sys_time;         /* System overhead for previous frame */
    unsigned long tree_time;        /* Typical tree decode time (not skip) */
    unsigned long wave_time;        /* Typical wavelet transform time */
    unsigned long dpy_time;         /* Typical display time */
    unsigned long run_time;         /* Time of first run frame */
    unsigned long key_time;         /* Time at last key frame */
    unsigned long sync_time;        /* Sync time */
    Boolean out[15];                /* Displayed? */
    SharedGlobals   *sharedGlob;
} Globals;

/* Scaling scenarios: Tree Wave Out
 *
 *  1  1  0: Internal calculations are Quarter size, output Original size (interpo
 *  1  1  1: Internal calculations are Quarter size, output Quarter size
 *  0  1  1: Internal calculations are Original size, output Quarter size
 *  0  0  0: Internal calculations are Original size, output Original size
 *  0  0 -1: Internal calculations are Original size, output Double size
 */

void    KLDeallocate(Globals **glob);

/* Klics Function Definitions */

extern  int     KlicsEncode(short *src[3], short *dst[3], KlicsE kle);
extern  Boolean KlicsDecode(short *src[3], short *dst[3], KlicsSeqHeader *seqh,Kli
    long mode, long scale[3], unsigned long *tree, unsigned long *wave);

/*****************************************
 *
 *  Memory allocation/deallocation routines
 *
 *****************************************/

OSErr
MemoryError()
{
    OSErr   theErr;

#ifdef DEBUG
    if (0!=(theErr=MemError()))
        DebugStr("\pMemoryError");
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
#endif
    return(theErr);
}

CSErr
FreePtr(Ptr *ptr)
{
    CSErr   theErr=0;

    if (*ptr!=nil) {
        DisposePtr(*ptr);
        *ptr=nil;
        theErr=MemoryError();
    }
    return(theErr);

}

#define FreePointer(handle,err) \
    if (noErr!=(err=FreePtr((Ptr*)(&handle)))) return(err)

extern  OSErr   Colour8(Ptr *);
extern  OSErr   Colour16(Ptr *);
extern  OSErr   UV32Table(Ptr *);
extern  OSErr   RGBTable(Ptr *);

OSErr
KLGetTab(Globals **glob,long new)
{
    OSErr   theErr=0;
    SharedGlobals   *sGlob=(*glob)->sharedGlob;
    long    old=(*glob)->using;

    if (old!=new) {
        if (old!=None) {
            sGlob->use[old-1]--;
            if (sGlob->use[old-1]==0) {
                FreePointer(sGlob->tab[old-1],theErr);
            }
        }

        if (new!=None) {
            if (sGlob->use[new-1]==0)
                switch(new) {
#ifndef ENCODER
                case Use8:
                    if (noErr!=(theErr=Colour8(&sGlob->tab[new-1])))
                        return(theErr);
                    break;
                case Use16:
                    if (noErr!=(theErr=Colour16(&sGlob->tab[new-1])))
                        return(theErr);
                    break;
                case Use32:
                    if (noErr!=(theErr=UV32Table(&sGlob->tab[new-1])))
                        return(theErr);
                    break;
#endif
#ifndef DECODER
                case UseF32:
                    if (noErr!=(theErr=RGBTable(&sGlob->tab[new-1])))
                        return(theErr);
                    break;
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
#endif
                )
            (*glob)->usingsnew;
            sGlob->use[new-1]++;
        }
    :
    return(theErr);
;


OSErr
XLFree(Globals **glob)
{
    OSErr   theErr=0;

    FreePointer((*glob)->src[0],theErr);
    FreePointer((*glob)->dst[0],theErr);
    FreePointer((*glob)->pixmap,theErr);
    (*glob)->size=0;
    return(theErr);
}

#define NewPointer(ptr,type,size) \
    saveZone=GetZone(); \
    SetZone(SystemZone()); \
    if (nil==(ptr=(type)NewPtr(size))) { \
        SetZone(ApplicZone()); \
        if (nil==(ptr=(type)NewPtr(size))) { \
            SetZone(saveZone); \
            return(MemoryError()); \
        } \
    } \
    SetZone(saveZone);


ComponentResult
XLMalloc(Globals **glob, short height, short width, long pixelSize)
{
    long    ysize,uvsize;
    THz     saveZone;

    ysize= (long)height * (long)width * (long)sizeof(short);
    uvsize = ysize>>2;

    if ((*glob)->size != ysize) {
        XLFree(glob);
        (*glob)->size = ysize;
        (*glob)->prev_frame=-1; /* frame doesn't contain valid data */

        /* Keep Src and Dst separate because of their large sizes */

        ysize=(long)height * (long)width * (long)sizeof(short) >> 2*(*glob)->scale
        uvsize = ysize>>2;
        NewPointer((*glob)->src[0],short *,ysize+uvsize+uvsize+16);
        (*glob)->src[1] = (short *)(((long)(*glob)->src[0] + ysize + 3L) & 0xFFFFF
        (*glob)->src[2] = (short *)(((long)(*glob)->src[1] + uvsize + 3L) & 0xFFFF

        ysize=(long)height * (long)width * (long)sizeof(short) >> 2*(*glob)->scale
        uvsize = ysize>>2;
        NewPointer((*glob)->dst[0],short *,ysize+uvsize+uvsize+16);
        (*glob)->dst[1] = (short *)(((long)(*glob)->dst[0] + ysize + 3L) & 0xFFFFF
        (*glob)->dst[2] = (short *)(((long)(*glob)->dst[1] + uvsize + 3L) & 0xFFFF
```

```
                    Engineering:KlicsCode:CompPict:KlicsCodec.c

        NewPointer((*glob)->pixMap.Ptr.pixelSize/8*height*width<<1);
    }
    return(noErr);
}

CSErr
ResourceError()
{
    OSErr   theErr;

#ifdef DEBUG
    if (0!=(theErr=ResError()))
        DebugStr("\pResourceError");
#endif
    return(theErr);
}

#ifdef COMPONENT
    #define ResErr(resfile,err) \
        if (0!=(err=ResourceError())) { \
            if (resfile!=0) CloseComponentResFile(resfile); \
            return(err); \
        }
#else
    #define ResErr(resfile,err) \
        if (0!=(err=ResourceError())) { \
            return(err); \
        }
#endif

ComponentResult
KLOpenInfoRes(ComponentInstance self, Handle *info)
{
#pragma unused(self)
    short   resFile=0;
    OSErr   theErr=noErr;

    if (*info) {
        DisposHandle(*info);
        *info=nil;
    }
#ifdef COMPONENT
    resFile=OpenComponentResFile((Component)self);
    ResErr(resFile,theErr);
#else
    UseResFile(gResRef);
#endif
    *info=Get1Resource(codecInfoResourceType,128);
    *info=Get1Resource(codecInfoResourceType,129);
    ResErr(resFile,theErr);
    LoadResource(*info);
    ResErr(resFile,theErr);
    DetachResource(*info);
#ifdef COMPONENT
    CloseComponentResFile(resFile);
#endif
    return(theErr);
}

pascal ComponentResult
KLOpenCodec(ComponentInstance self)
{
    Globals         **glob;
```

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```
    SharedGlobals   *sGlob;
    THz             saveZone;
    Boolean         inAppHeap;
    ComponentResult result = noErr;
    short   resFile=CurResFile();

    DebugMsg("\pOpen Codec - begin");
    if ( (glob = (Globals **)NewHandleClear(sizeof(Globals)) ) == nil )  {
        return(MemoryError());
    } else HNoPurge((Handle)glob);
    SetComponentInstanceStorage(self,(Handle)glob);

    saveZone = GetZone();
    inAppHeap = ( GetComponentInstanceA5(self) != 0 );
    if ( !inAppHeap )
        SetZone(SystemZone());
    if ( (sGlob=(SharedGlobals*)GetComponentRefcon((Component)self)) == nil  ) {
        if ( (sGlob = (SharedGlobals*)NewPtrClear(sizeof(SharedGlobals))) == nil )
            result=MemoryError();
            goto obail;
        }
        SetComponentRefcon((Component)self,(long)sGlob);
    }

    (*glob)->sharedGlob = sGlob;    // keep this around where it's easy to get at

    if ( sGlob->info == nil || *(Handle)sGlob->info == nil  )  {
        result=KLOpenInfoRes(self,&(Handle)(sGlob->info));
        HNoPurge((Handle)sGlob->info);
    }

obail:

    SetZone(saveZone);
    if ( result != noErr && sGlob != nil ) {
        if ( sGlob->info )
            DisposHandle((Handle)sGlob->info);
        DisposPtr((Ptr)sGlob);
        SetComponentRefcon((Component)self,(long)nil);
    }
    (*glob)->size=0;
    DebugMsg("\pOpen Codec - end");
    return(result);
}

pascal ComponentResult
KLCloseCodec(Handle storage,ComponentInstance self)
{
    SharedGlobals   *sGlob;
    Globals         **glob = (Globals **)storage;

    DebugMsg("\pClose Codec - begin");
    HLock(storage);
    if ( glob ) {
        KLFree(glob);
        KLGetTab(glob,None);
        if (CountComponentInstances((Component)self) == 1) {
            if ( (sGlob=(SharedGlobals*)(*glob)->sharedGlob) != nil  ) {
                if ( sGlob->info )
                    HPurge((Handle)sGlob->info);
            }
        }
        DisposHandle((Handle)glob);
```

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```
        height = 120;
        }
    if (time)
        *time = (width * height * 1L);

    if (spatialQuality && *spatialQuality==codecLosslessQuality)
        *spatialQuality = codecMaxQuality;

    if (temporalQuality && *temporalQuality==codecLosslessQuality)
        *temporalQuality = codecMaxQuality;

    return(noErr);
}

/*
 * Extends dimensions to make a multiples of 32x16
 */

#define KLExtendWidth(dim)  31-(dim-1&31)
#define KLExtendHeight(dim) 15-(dim-1&15)

pascal ComponentResult
KLGetMaxCompressionSize(Handle storage,PixMapHandle src,const Rect *srcRect,short
    CodecQ quality,long *size)
{
#pragma unused(storage,src,depth,quality)
    short width = srcRect->right - srcRect->left;
    short height = srcRect->bottom - srcRect->top;

    /*  test by just doing RGB storage */

    *size = 3 * (width+KLExtendWidth(width)) * (height+KLExtendHeight(height));
    return(noErr);
}

pascal ComponentResult
KLGetCompressedImageSize(Handle storage,ImageDescriptionHandle desc,Ptr data,long
    DataProcRecordPtr dataProc,long *size)
{
#pragma unused(storage,dataSize,dataProc,desc)
    short   frmh_size;
    long    data_size;

    if ( size == nil ) {
        return(paramErr);
    }
    frmh_size=((KlicsHeader *)data)->description_length;
    data_size=((KlicsFrameHeader *)data)->length;
    *size=(long)frmh_size+data_size;
    return(noErr);
}

void    KLSetup(Boolean still, short width, short height, CodecQ space, CodecQ tem
{
    kle->seqh.head.description_length=sizeof(KlicsSeqHeader);
    kle->seqh.head.version_number[0]=0;
    kle->seqh.head.version_number[1]=1;
    kle->seqh.sequence_size[0]=width;
    kle->seqh.sequence_size[1]=height;
    kle->seqh.sequence_size[2]=0;
    kle->seqh.sub_sample[0]=1;
    kle->seqh.sub_sample[1]=1;
    kle->seqh.wavelet=WT_Daub4;
```

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```
    kle->seqh.precision=10;
    kle->seqh.octaves[0]=3;
    kle->seqh.octaves[1]=2;

    kle->frmh.head.description_length=sizeof(KlicsFrameHeader);
    kle->frmh.head.version_number[0]=0;
    kle->frmh.head.version_number[1]=1;

    kle->encd.bpf_in=(2133+temp*160)/8;        /* High = 64000 bits/frame, Poor = 1
    kle->encd.bpf_out=kle->encd.bpf_in;
    kle->encd.buf_size=kle->encd.bpf_in*4;

    kle->encd.quant=16-(space*15)/1023;
    kle->encd.thresh=1.0;
    kle->encd.compare=1.0;
    kle->encd.base[0]=0.10;
    kle->encd.base[1]=0.10;
    kle->encd.base[2]=0.20;
    kle->encd.base[3]=0.50;
    kle->encd.base[4]=1.00;
    kle->encd.intra=still;
    kle->encd.auto_q=true;
    kle->encd.buf_sw=true;
    kle->encd.prevquact=1;
    kle->encd.prevbytes=13;
}

#ifndef DECODER
pascal ComponentResult
KLPreCompress(Handle storage,register CodecCompressParams *p)
{
    ComponentResult     result;
    CodecCapabilities   *capabilities = p->capabilities;
    short               width=(*p->imageDescription)->width+(capabilities->extendW
    short               height=(*p->imageDescription)->height+(capabilities->exten
    Globals             **glob=(Globals **)storage;
    KlicsE              kle=&(*glob)->kle;
    Handle              ext=NewHandle(sizeof(KlicsSeqHeader));

    DebugMsg("\pKLPreCompress");
    HLock(storage);
    if (MemError()!=noErr) return(MemError());
    switch ( (*p->imageDescription)->depth )  (
        case 24:
            capabilities->wantedPixelSize = 32;
            kle->seqh.channels=3;
            if (noErr!=(result=KLGetTab(glob,UseF32)))
                return(result);
            break;
        default:
            return(codecConditionErr);
            break;
    }

    /* Going to use 3 octaves for Y and 2 for UV so the image must be a multiple o

    capabilities->bandMin = height;
    capabilities->bandInc = capabilities->bandMin;

    capabilities->flags=codecCanCopyPrevComp|codecCanCopyPrev;

    (*glob)->scale[0]=0;
    (*glob)->scale[1]=0;
```

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```
    (*glob)->scale[2]=0;

    if (noErr!=(result=KLMalloc(glob,height,width,0))) return result;
    KLSetup(p->sequenceID==0,width,height,(*p->imageDescription)->spatialQuality,(

    BlockMove((Ptr)&kle->seqh,*ext,sizeof(KlicsSeqHeader));
    if (noErr!=(result=SetImageDescriptionExtension(p->imageDescription,ext,klicsC
    return result;

    HUnlock(storage);
    DebugMsg("\pKLPreCompress success");
    return(result);
}
#endif

#ifndef ENCODER
pascal long
KLPreDecompress(Handle storage,register CodecDecompressParams *p)
{
    ComponentResult     result;
    CodecCapabilities   *capabilities = p->capabilities;
    Rect                dRect = p->srcRect;
    long                width;
    long                height;
    long                channels;
    Globals             **glob=(Globals **)storage;
    KlicsE              kle;
    Handle              ext;
    OSErr       err;

    DebugMsg("\pKLPreDecompress");
    if ( !TransformRect(p->matrix,&dRect,nil) )
        return(codecConditionErr);

    HLock(storage);
    kle=&(*glob)->kle;
    switch ( (*p->imageDescription)->depth )  {
        case 24:
            switch(p->dstPixMap.pixelSize) {
            case 32:
                capabilities->wantedPixelSize = 32;
                if (p->conditionFlags&codecConditionNewDepth) {
                    if (noErr!=(err=KLGetTab(glob,Use32)))
                        return(err);
                }
                break;
            case 16:
                capabilities->wantedPixelSize = 16;
                if (p->conditionFlags&codecConditionNewDepth) {
                    if (noErr!=(err=KLGetTab(glob,Use16)))
                        return(err);
                }
                break;
            case 8:
                capabilities->wantedPixelSize = 8;
                if (p->conditionFlags&codecConditionNewClut) {
                    if (noErr!=(err=KLGetTab(glob,Use8)))
                        return(err);
                }
                break;
            }
            channels=3;
            break;
```

```
        default:
            return(codecConditionErr);
            break;
    }

    if (noErr!=(result=GetImageDescriptionExtension(p->imageDescription,&ext,klics
    BlockMove(*ext,(Ptr)&kle->seqh,sizeof(KlicsSeqHeader));
    if (channels==1) kle->seqh.channels=1;

    /* Going to use 3 octaves for Y and 2 for UV so the image must be a multiple o

#ifdef HQ
    (*glob)->scale[0]=0; /* Tree scale */
#else
    (*glob)->scale[0]=1; /* Tree scale */
#endif
    width=kle->seqh.sequence_size[0];
    height=kle->seqh.sequence_size[1];

    switch((*glob)->scale[0]) {
    case 1: /* Quarter size internal */
        (*glob)->scale[1]=1;
        if (p->matrix->matrix[0][0]==p->matrix->matrix[1][1])
            switch(p->matrix->matrix[0][0]) {
            case 32768:
                capabilities->flags=codecCanScale;
                capabilities->extendWidth=width/2-dRect.right;
                capabilities->extendHeight=height/2-dRect.bottom;
                (*glob)->scale[2]=1;
                break;
            case 65536:
                capabilities->extendWidth=width-dRect.right;
                capabilities->extendHeight=height-dRect.bottom;
                (*glob)->scale[2]=0;
                break;
            default:
                capabilities->extendWidth=0;
                capabilities->extendHeight=0;
                (*glob)->scale[2]=0;
                break;
            }
        else {
            capabilities->extendWidth=0;
            capabilities->extendHeight=0;
            (*glob)->scale[2]=0;
        }
        break;
    case 0: /* Full size internal */
        if (p->matrix->matrix[0][0]==p->matrix->matrix[1][1])
            switch(p->matrix->matrix[0][0]) {
            case 32768:
                capabilities->flags=codecCanScale;
                capabilities->extendWidth=width/2-dRect.right;
                capabilities->extendHeight=height/2-dRect.bottom;
                (*glob)->scale[1]=1;
                (*glob)->scale[2]=1;
                break;
            case 131072:
                capabilities->flags=codecCanScale;
                capabilities->extendWidth=width*2-dRect.right;
                capabilities->extendHeight=height*2-dRect.bottom;
                (*glob)->scale[1]=0;
                (*glob)->scale[2]=-1;
```

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```
                break;
            case 65536:
                capabilities->extendWidth=width-dRect.right;
                capabilities->extendHeight=height-dRect.bottom;
                (*glob)->scale[1]=0;
                (*glob)->scale[2]=0;
                break;
            default:
                capabilities->extendWidth=0;
                capabilities->extendHeight=0;
                (*glob)->scale[1]=0;
                (*glob)->scale[2]=0;
            }
        else {
            capabilities->extendWidth=0;
            capabilities->extendHeight=0;
            (*glob)->scale[1]=0;
            (*glob)->scale[2]=0;
        }
        break;
    }

    capabilities->bandMin = height;
    capabilities->bandInc = capabilities->bandMin;
    capabilities->flags|=codecCanCopyPrev|codecCanCopyPrevComp|codecCanRemapColor;

    if (noErr!=(result=KLMalloc(glob,height,width,capabilities->wantedPixelSize)))

    HUnlock(storage);
    DebugMsg("\pKLPreDecompress success");
    return(result);
}
#endif

/* Test Versions in C - Colour.c */
void    RGB2YUV32(long *pixmap, short *Yc, short *Uc, short *Vc, int area, int wid
void    YUV2RGB32(long *pixmap, short *Yc, short *Uc, short *Vc, int area, int wid
void    YUV2RGB32x2(Ptr table,long *pixmap, short *Yc, short *Uc, short *Vc, int a

/* Assembler versions - Colour.a */
OUT32X2(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,l
OUT32X2D(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,
OUT32(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,lon
OUT32D(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,lo
OUT8X2(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,lo
OUT8(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,long
OUT16X2(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,l
OUT16(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,lon
IN32(Ptr table,long *pixmap,short *Y,short *U,short *V,long width,long height,long

/* Assembler versions - Color2.a */
void    RGB2YUV2(long *pixmap, short *Yc, short *Uc, short *Vc, int area, int widt
void    YUV2RGB2(long *pixmap, short *Yc, short *Uc, short *Vc, int area, int widt
void    YUV2RGB3(long *pixmap, short *Yc, short *Uc, short *Vc, int area, int widt
void    GREY2Y(long *pixmap, short *Yc, int area, int width, int cols);
void    Y2GREY(long *pixmap, short *Yc, int lines, int width, int cols);
void    Y2GGG(long *pixmap, short *Yc, int lines, int width, int cols);

/*YUV2RGB4((*glob)->Table,pixmap,src[0],src[1],src[2],cols*(*desc)->height>>scale,
YUV2RGB5((*glob)->Table,pixmap,src[0],src[1],src[2],cols*(*desc)->height,width>>sc

#pragma parameter __D0 MicroSeconds
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
pascal  unsigned long MicroSeconds(void) = {0x4EB0, 0x81E1, 0x64C};

unsigned long   GetTimerValue(unsigned long *TimerRes)
{
    *TimerRes = CLOCKS_PER_SEC;
    return(MicroSeconds());
}

#ifndef DECODER
pascal long
KLBandCompress(Handle storage,register CodecCompressParams *p)
{
#pragma unused(storage)
    Globals             **glob  = (Globals **)storage;
    ImageDescription    **desc = p->imageDescription;
    char                *baseAddr;
    short               rowBytes;
    Rect                sRect;
    long                offsetH,offsetV;
    OSErr               result = noErr;
    short               *src[3],*dst[3];
    long                *pixmap;
    int                 width=(*desc)->width+KLExtendWidth((*desc)->width);
    int                 height=(*desc)->height+KLExtendHeight((*desc)->height);
    int                 hwidth=width>>1,hheight=height>>1;
    int                 bytes;
    KlicsE              kle;
    char                mmuMode=1;
    char                intra[]="\pENC:Intra-mode", inter[]="\pENC:Inter-mode";
    SharedGlobals       *sGlob;

#ifdef PERFORMANCE
    (void)PerfControl(ThePGlobals,true);
#endif

    DebugMsg("\pBandCompress");
    HLock((Handle)glob);
    kle=&(*glob)->kle;
    sGlob=(*glob)->sharedGlob;

    rowBytes = p->srcPixMap.rowBytes & 0x3fff;
    sRect =  p->srcPixMap.bounds;
    switch ( p->srcPixMap.pixelSize ) {
    case 32:
        offsetH = sRect.left<<2;
        break;
    case 16:
        offsetH = sRect.left<<1;
        break;
    case 8:
        offsetH = sRect.left;
        break;
    default:
        result = codecErr;
        DebugMsg("\pError");
        goto bail;
    }
    offsetV = sRect.top * rowBytes;
    baseAddr = p->srcPixMap.baseAddr + offsetH + offsetV;
    pixmap=(long *)baseAddr;

/*  FSMakeFSSpec(0,0,"\pUser:crap001",&fsspec);
    FSpCreate(&fsspec,'????','????',-1);
```

```
    FSpOpenDF(&fsspec,fsWrPerm,&fileRefNum);
    area=height*rowBytes;
    FSWrite(fileRefNum,&area,(long*)pixmap);
    FSClose(fileRefNum);*/

    src[0]=(*glob)->src[0]; src[1]=(*glob)->src[1]; src[2]=(*glob)->src[2];
    dst[0]=(*glob)->dst[0]; dst[1]=(*glob)->dst[1]; dst[2]=(*glob)->dst[2];
    switch(kle->seqh.channels) {
    case 3:
        IN32(sClob->tab[UseF32-1],pixmap,src[0],src[1],src[2],width,height,rowByte
        break;
    }


    /************************************************
     *
     *  Klics encode
     *
     ************************************************/
#ifdef DEBUG
    if (p->callerFlags&codecFlagUseImageBuffer) DebugStr("\pUseImageBuffer");   /*
    if (p->callerFlags&codecFlagUseScreenBuffer) DebugStr("\pUseScreenBuffer"); /*
    if (p->callerFlags&codecFlagUpdatePrevious) DebugStr("\pUpdatePrevious");   /*
    if (p->callerFlags&codecFlagNoScreenUpdate) DebugStr("\pNoScreenUpdate");   /*
    if (p->callerFlags&codecFlagDontOffscreen) DebugStr("\pDontOffscreen");     /*
    if (p->callerFlags&codecFlagUpdatePreviousComp) DebugStr("\pUpdatePreviousComp
    if (p->callerFlags&codecFlagForceKeyFrame) DebugStr("\pForceKeyFrame");     /*
    if (p->callerFlags&codecFlagOnlyScreenUpdate) DebugStr("\pOnlyScreenUpdate");
#endif

    kle->buf.buf=(unsigned long *)(p->data+sizeof(KlicsFrameHeader));
    kle->encd.intra=(p->temporalQuality==0);
    kle->frmh.frame_number=p->frameNumber;

    bytes=KlicsEncode(src,dst,kle);

    BlockMove((Ptr)&kle->frmh,p->data,sizeof(KlicsFrameHeader));
    bytes+=sizeof(KlicsFrameHeader);

    (*glob)->prev_frame=p->frameNumber;

    p->data+=bytes;
    p->bufferSize=bytes;
    (*p->imageDescription)->dataSize=bytes;

    p->similarity=(kle->encd.intra?0:Long2Fix(244));
    p->callerFlags=0;
/*  p->callerFlags|=codecFlagUsedImageBuffer|(kle->encd.intra?codecFlagUsedNewImag

bail:

    HUnlock((Handle)glob);
#ifdef PERFORMANCE
    if(0!=(result=PerfDump(ThePGlobals,"\pEncode.perf",false,0)))
        return(result);
#endif
    DebugMsg("\pBandCompress success");
    return(result);
}
#endif

/* Display stuff for debugging
   CGrafPtr    wPort, savePort;
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
    Rect        rect;
    Str255      str;

    GetPort((GrafPtr *)&savePort);
    GetCWMgrPort(&wPort);
    SetPort((GrafPtr)wPort);
    SetRect(&rect,0,0,50,30);
    ClipRect(&rect);
    EraseRect(&rect);
    NumToString(frmh->frame_number,str);
    MoveTo(0,20);
    DrawString(str);
    if (frmh->flags&KFH_INTRA) {
        SetRect(&rect,0,30,50,65);
        ClipRect(&rect);
        EraseRect(&rect);
        NumToString(frmh->frame_number/24,str);
        MoveTo(0,50);
        DrawString(str);
    }
    SetRect(&rect,-2000,0,2000,2000);
    ClipRect(&rect);
    SetPort((GrafPtr)savePort);*/

#define flag_tree   0x1
#define flag_wave   0x2
#define flag_show   0x4
#define flag_full   0x8
#define DURATION    65666

long    ModeSwitch(Globals *glob,KlicsFrameHeader *frmh)
{
    long    mode=0, i, fps;
    Boolean repeat=glob->prev_frame==frmh->frame_number,
            next=glob->prev_frame+1==frmh->frame_number;
    CGrafPtr    wPort, savePort;
    Rect        rect;
    Str255      str;

    DebugMsg("\pModeSwitch - begin");
    if (frmh->frame_number==0)
        for(i=0;i<15;i++) glob->out[i]=false;
    if (repeat) {
        glob->run_time=0;
        DebugMsg("\pModeSwitch - repeat (end)");
        return(flag_show|flag_full);
    }

    if (next)
        switch(frmh->flags) {
        case KFH_SKIP:
            DebugMsg("\pModeSwitch - next/skip");
            glob->prev_frame=frmh->frame_number;
            if (glob->sys_time>DURATION) {
                glob->run_time=0;
                if (glob->real_frame!=glob->dpy_frame)
                    mode|=flag_wave|flag_show;
            } else {
                unsigned long frame, late;

                frame=glob->run_frame+(glob->sync_time-glob->run_time)/DURATION;
                late=(glob->sync_time-glob->run_time)%DURATION;
                if (frame<=glob->prev_frame && glob->real_frame!=glob->dpy_frame)
```

```
                mode|=flag_wave|flag_show;
/*              if (frame<=glob->prev_frame && late+glob->wave_time+glob->spy_time
                    mode|=flag_wave flag_show;*/
            }
            break;
        case KFH_INTRA:
            DebugMsg("\pModeSwitch - next/intra");
            mode=flag_tree;
            glob->prev_frame=frmh->frame_number;
            glob->real_frame=glob->prev_frame;
            if (glob->sys_time>DURATION) {
                glob->run_time=0;
                mode|=flag_wave|flag_show|flag_full;
            } else
/*              if (glob->run_time==0) {*/
                    glob->key_time=glob->sync_time-glob->run_time;
                    glob->run_time=glob->sync_time-glob->sys_time;
                    glob->run_frame=glob->prev_frame;
                    mode|=flag_wave|flag_show|flag_full;
/*              } else {
                    unsigned long frame, late;

                    frame=glob->run_frame+(glob->sync_time-glob->run_time)/DURATIO
                    late=(glob->sync_time-glob->run_time)%DURATION;
                    if (frame<=glob->prev_frame)
                        mode|=flag_wave|flag_show|flag_full;
                }*/
            break;
        default:
            DebugMsg("\pModeSwitch - next/inter");
            mode=flag_tree;
            glob->prev_frame=frmh->frame_number;
            glob->real_frame=glob->prev_frame;
            if (glob->sys_time>DURATION) {
                glob->run_time=0;
                mode|=flag_wave|flag_show;
            } else
                if (glob->run_time==0) {
                    glob->run_time=glob->sync_time-glob->sys_time;
                    glob->run_frame=glob->prev_frame;
                    mode|=flag_wave|flag_show;
                } else {
                    unsigned long frame, late;

                    frame=glob->run_frame+(glob->sync_time-glob->run_time)/DURATIO
                    late=(glob->sync_time-glob->run_time)%DURATION;
                    if (frame<=glob->prev_frame)
                        mode|=flag_wave|flag_show;
/*                  if (frame<=glob->prev_frame && late+glob->tree_time+glob->wave
                        mode|=flag_wave|flag_show;*/
                }
            break;
    }
    else
        switch(frmh->flags) {
        case KFH_SKIP:
            DebugMsg("\pModeSwitch - jump/skip");
            glob->run_time=0;
            break;
        case KFH_INTRA:
            DebugMsg("\pModeSwitch - jump/intra");
            mode=flag_tree|flag_wave|flag_show|flag_full;
            for(i=glob->prev_frame;i<frmh->frame_number;i++)
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
            =  glob->out[frmh->frame_number%15]=0;
            glob->prev_frame=frmh->frame_number;
            glob->real_frame=glob->prev_frame;
            glob->run_time=0;
            break;
        default:
            DebugMsg("\pModeSwitch - jump/inter");
            glob->run_time=0;
            break;
        }
    DebugMsg("\pModeSwitch - display info");
#ifndef COMPONENT
/*  glob->out[frmh->frame_number%15]=(mode&flag_show)!=0;
    for(i=0,fps=0;i<15;i++) if (glob->out[i]) fps++;
    GetPort((GrafPtr *)&savePort);
    GetCWMgrPort(&wPort);
    SetPort((GrafPtr)wPort);
    SetRect(&rect,0,20,120,50);
    ClipRect(&rect);
    EraseRect(&rect);
    NumToString(frmh->frame_number,str);
    MoveTo(0,35);
    DrawString(str);
    DrawString("\p:");
    NumToString(fps,str);
    DrawString(str);
    MoveTo(0,50);
    for(i=0;i<15;i++)
        if (glob->out[i]) DrawString("\pX");
        else DrawString("\p0");
    SetRect(&rect,-2000,0,2000,2000);
    ClipRect(&rect);
    SetPort((GrafPtr)savePort);*/
#endif
    DebugMsg("\pModeSwitch - end");
    return(mode);
}

#ifndef ENCODER
pascal long
KLBandDecompress(Handle storage,register CodecDecompressParams *p)
{
#pragma unused(storage)
    Globals **glob  = (Globals **)storage;
    ImageDescription    **desc = p->imageDescription;
    int                 x,y;
    char                *baseAddr;
    short               rowBytes;
    Rect                dRect;
    long                offsetH,offsetV;
    OSErr               result = noErr;
    short               *src[3],*dst[3];
    long                *pixmap;
    int                 width=(*desc)->width+KLExtendWidth((*desc)->width);
    int                 height=(*desc)->height+KLExtendHeight((*desc)->height);
    int                 hwidth=width>>1,hheight=height>>1,area=height*width;
    KlicsZ              klz;
    KlicsFrameHeader    *frmh;
    char                mmuMode=1;
    long                mode;
    SharedGlobals       *sGlob;
/*
    FILE                *fp;
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
    char            file_name[32];
    CGrafPtr        wPort, savePort;
    Rect            rect;
    Str255          str;
*/

    HLock((Handle)glob);
    DebugMsg("\pBandDecompress");
    (*glob)->sys_time=GetTimerValue(&(*glob)->sys_time);
    (*glob)->sys_time-=(*glob)->sync_time;

#ifdef PERFORMANCE
    (void)PerfControl(ThePGlobals,true);
#endif

    kle=&(*glob)->kle;
    sGlob=(*glob)->sharedGlob;

    dRect = p->srcRect;
    if ( !TransformRect(p->matrix,&dRect,nil) ) {
        DebugMsg("\pTransformRect Error");
        return(paramErr);
    }
    rowBytes = p->dstPixMap.rowBytes & 0x3fff;
    offsetH = (dRect.left - p->dstPixMap.bounds.left);
    switch (  p->dstPixMap.pixelSize ) {
    case 32:
        offsetH <<=2;
        break;
    case 16:
        offsetH <<=1;
        break;
    case 8:
        break;
    default:
        result = codecErr;
        DebugMsg("\pDepth Error");
        goto bail;
    }
    offsetV = (dRect.top - p->dstPixMap.bounds.top) * rowBytes;
    baseAddr = p->dstPixMap.baseAddr + offsetH + offsetV;
    pixmap=(long *)baseAddr;

    /************************************************
     *
     *  Klics decode
     *
     ************************************************/

    src[0]=(*glob)->src[0]; src[1]=(*glob)->src[1]; src[2]=(*glob)->src[2];
    dst[0]=(*glob)->dst[0]; dst[1]=(*glob)->dst[1]; dst[2]=(*glob)->dst[2];

    frmh=(KlicsFrameHeader *)p->data;
    kle->buf.buf=(unsigned long *)(p->data+sizeof(KlicsFrameHeader));
    mode=ModeSwitch(*glob,frmh);

    KlicsDecode(src,dst,&kle->seqh,frmh,&kle->buf,mode,(*glob)->scale,&(*glob)->tr

    if ( kle->buf.ptr-kle->buf.buf > frmh->length+2)
        DebugMsg("\pWarning: Decompressor read passed end of buffer");

    p->data[0]='X';
    p->data[1]=mode&flag_tree?'T':' ';
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
    p->data[2]=mode&flag_wave?'W':' ';
    p->data[3]=mode&flag_show?'S':' ';
    p->data[4]=mode&flag_full?'F':' ';
    p->data[5]=frmh->flags&KFH_INTRA?'I':' ';
    p->data[6]=frmh->flags&KFH_SKIP?'K':' ';
    p->data[7]='X';

    p->data+=p->bufferSize;

    /*************************************************
     *
     *  signed 10 bit YUV-unsigned 8 RGB convert
     *
     *************************************************/

#ifdef COMPONENT
    SwapMMUMode(&mmuMode);
#endif
    if (mode&flag_show) {
        (*glob)->sync_time=GetTimerValue(&(*glob)->sync_time);
        (*glob)->dpy_frame=(*glob)->real_frame;
        if ((*glob)->scale[2]<(*glob)->scale[1]) {
            switch(kle->seqh.channels) {
            case 3:
                switch (p->dstPixMap.pixelSize) {
                case 32:
                    if (mode&flag_full)
                        OUT32X2(sGlob->tab[Use32-1],pixmap,src[0],src[1],src[2],wi
                    else
                        OUT32X2D(sGlob->tab[Use32-1],pixmap,src[0],src[1],src[2],w
                    break;
                case 16:
                    OUT16X2(sGlob->tab[Use16-1],pixmap,src[0],src[1],src[2],width>
                    break;
                case 8:
                    OUT8X2(sGlob->tab[Use8-1],pixmap,src[0],src[1],src[2],width>>(
                    break;
                }
                break;
            }
        } else {
            switch(kle->seqh.channels) {
            case 3:
                switch (p->dstPixMap.pixelSize) {
                case 32:
                    if (mode&flag_full)
                        OUT32(sGlob->tab[Use32-1],pixmap,src[0],src[1],src[2],widt
                    else
                        OUT32D(sGlob->tab[Use32-1],pixmap,src[0],src[1],src[2],wid
                    break;
                case 16:
                    OUT16(sGlob->tab[Use16-1],pixmap,src[0],src[1],src[2],width>>(
                    break;
                case 8:
                    OUT8(sGlob->tab[Use8-1],pixmap,src[0],src[1],src[2],width>>(*g
                    break;
                }
                break;
            }
        }
        (*glob)->dpy_time=GetTimerValue(&(*glob)->dpy_time);
        (*glob)->dpy_time-=(*glob)->sync_time;
    }
```

Engineering:KlicsCode:CompPict:KlicsCodec.c

```
    CLEARA2();
    (*glob)->sync_time=GetTimerValue(&(*glob)->sync_time);

#ifdef COMPONENT
    SwapMMUMode(&mmuMode);
#endif

tail:
    HUnlock((Handle)glob);

#ifdef PERFORMANCE
    if(0!=(result=PerfDump(ThePGlobals,"\pDecode.perf",false,0)))
        return(result);
#endif
    DebugMsg("\pBandDecompress success");
    return(result);
}
#endif
```

Engineering:KlicsCode:CompPict:Klics.h

```
/*************************************
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 *************************************/
/*
 *  Second generation header file
 */

#include    <stdio.h>

/* useful X definitions */
/*typedef   char    Boolean;*/
typedef char    *String;
#define True    1
#define False   0

/* new Blk definition */
typedef int     Blk[4];

#define WT_Haar  0
#define WT_Daub4 1

/* mode constructors */
#define M_LPF   1
#define M_STILL 2
#define M_SEND  4
#define M_STOP  8
#define M_VOID  16
#define M_QUIT  32

/* LookAhead histogram */
#define HISTO   300
#define HISTO_DELTA 15.0
#define HISTO_BITS 10

/* Fast Functions */

/* Is the block all zero ? */
#define BlkZero(block) \
    block[0]==0 && block[1]==0 && block[2]==0 && block[3]==0

/* Sum of the absolute values */
#define Decide(new) \
    abs(new[0])+ \
    abs(new[1])+ \
    abs(new[2])+ \
    abs(new[3])

/* Sum of the absolute differences */
#define DecideDelta(new,old) \
    abs(new[0]-old[0])+ \
    abs(new[1]-old[1])+ \
    abs(new[2]-old[2])+ \
    abs(new[3]-old[3])

/* Adjust the norm for comparison with SigmaAbs */
#define DecideDouble(norm) (4.0*norm)

/* Get addresses from x,y coords of block, sub-band, octave,
```

Engineering:KiicsCode:CompPict:Kiics.h

```
 * image size and mask (directly related to octave) information
 */
#define GetAddr(addr,x,y,sub,oct,size,mask) \
{ int   smask=mask>>1, \
        x0=x|(sub&1?smask:0), \
        x1=x|(sub&1?smask:0)|mask, \
        y0=(y|(sub&2?smask:0))*size[0], \
        y1=(y|(sub&2?smask:0)|mask)*size[0]; \
\
    addr[0]=x0+y0; \
    addr[1]=x1+y0; \
    addr[2]=x0+y1; \
    addr[3]=x1+y1; \
}

/* Get data values from addresses and memory */
#define GetData(addr,block,data) \
    block[0]=(int)data[addr[0]]; \
    block[1]=(int)data[addr[1]]; \
    block[2]=(int)data[addr[2]]; \
    block[3]=(int)data[addr[3]];

#define VerifyData(block,mask,tmp) \
    tmp=block&mask; \
    if (tmp!=0 && tmp!=mask) { \
        block=block<0?mask:-mask; \
    }

/* Put data values to memory using addresses */
#define PutData(addr,block,data) \
    data[addr[0]]=(short)block[0]; \
    data[addr[1]]=(short)block[1]; \
    data[addr[2]]=(short)block[2]; \
    data[addr[3]]=(short)block[3];

/* Put zero's to memory using addresses */
#define PutZero(addr,data) \
    data[addr[0]]=0; \
    data[addr[1]]=0; \
    data[addr[2]]=0; \
    data[addr[3]]=0;

/* Mode: M_VOID Put zero's and find new mode */
#define DoZero(addr,dst,mode,oct) \
    PutZero(addr,dst); \
    mode[oct]=oct==0?M_STOP:M_VOID;

/* Descend the tree structure
 * Copy mode, decrement octave (& mask), set branch to zero
 */
#define DownCounters(mode,oct,mask,blk) \
    mode[oct-1]=mode[oct]; \
    oct--; \
    mask = mask>>1; \
    blk[oct]=0;

/* Ascend the tree structure
 * Ascend tree (if possible) until branch not 3
 * If at top then set mode to M_QUIT
 * Else increment branch and x, y coords
 */
#define StopCounters(mode,oct,mask,blk,x,y,octs) \
    while(oct<octs-1 && blk[oct]==3) { \
```

Engineering:KlicsCode:CompPict:Klics.h

```
    blk[oct]=0; \
    mask= mask<<1; \
    x &= ~mask; \
    y &= ~mask; \
    oct++; \
} \
if (oct==octs-1) mode[oct]=M_QUIT; \
else { \
    blk[oct]++; \
    x ^= mask<<1; \
    if (blk[oct]==2) y ^= mask<<1; \
    mode[oct]=mode[oct+1]; \
}
```

Engineering:KlicsCode:CompPict:Haar.a

```
*-------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*-------------------------------
*
*   68000 FastForward/Backward Haar
*
*-------------------------------
        macro
        Fwd0            &addr0,&dG,&dH
*
        move.w          (&addr0),&dG    ; dG=*(short *)addr1
        move.w          &dG,&dH         ; dH=dG
*
        endm
*-------------------------------
        macro
        Fwd1            &addr1,&addr0,&dG,&dH
*
        move.w          (&addr1),d0     ; v=*(short *)addr2
        add.w           d0,&dH          ; dH+=v
        sub.w           d0,&dG          ; dG-=v
        clr.w           d0              ; d0=0
        asr.w           #1,&dH          ; dAH>>=1
        addx.w          d0,&dH          ; round dH
        asr.w           #1,&dG          ; dG>>=1
        addx.w          d0,&dG          ; round dG
        move.w          &dH,(&addr0)    ; *(short *)addr0=dH
        move.w          &dG,(&addr1)    ; *(short *)addr1=dG
*
        mend
*-------------------------------
        macro
        Fwd             &base,&end,&inc
*
        movea.l         &base,a0                ; addr0=base
        move.l          &inc,d0                 ; d0=inc
        asr.l           #1,d0                   ; d0=inc>>1
        movea.l         a0,a1                   ; addr1=addr0
        suba.l          d0,a1                   ; addr1-=(inc>>1)
@do     Fwd0            a0,d4,d5                ; Fwd0(addr0,dG,dH)
        adda.l          &inc,a1                 ; addr1+=inc
        Fwd1            a1,a0,d4,d5             ; Fwd1(addr1,addr0,dG,dH)
        adda.l          &inc,a0                 ; addr0+=inc
        cmpa.l          a0,&end                 ; addr0<end
        bgt.s           @do                     ; while
*
        endm
*-------------------------------
HaarForward FUNC        EXPORT
*
        link            a6,#0                   ; no local variables
        movem.l         d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l          $000C(a6),d3            ; inc=inc1
        movea.l         $0008(a6),a5            ; base=data
        move.l          $0010(a6),d6            ; end1
        move.l          $0018(a6),d7            ; end2
        move.l          $0014(a6),d2            ; inc2
```

Engineering:KlicsCode:CompPict:Haar.a

```
@do     movea.l     a5,a4                   ; end=base
        adda.l      d6,a4                   ; end+=end1
        Fwd         a5,a4,d3                ; Fwd(base,end,inc)
        adda.l      d2,a5                   ; base+=inc2
        cmpa.l      d7,a5                   ; end2>base
        blt.s       @do                     ; for
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-----------------------------------
        macro
        Bwd0        &addr0,&dG,&dH
*
        move.w      (&addr0),&dG    ; dG=*(short *)addr0
        move.w      &dG,&dH         ; dH=dG
*
        endm
*-----------------------------------
        macro
        Bwd1        &addr1,&addr0,&dG,&dH
*
        move.w      (&addr1),d0     ; v=*(short *)addr1
        add.w       d0,&dH          ; dH+=v
        sub.w       d0,&dG          ; dG-=v
        move.w      &dH,(&addr0)    ; *(short *)addr0=dH
        move.w      &dG,(&addr1)    ; *(short *)addr1=dG
*
        endm
*-----------------------------------
        macro
        Bwd         &base,&count,&inc
*
        movea.l     &base,a0                ; addr0=base
        move.l      &inc,d0                 ; d0=inc
        asr.l       #1,d0                   ; d0=inc>>1
        movea.l     a0,a1                   ; addr1=addr0
        suba.l      d0,a1                   ; addr1-=(inc>>1)
@do     Bwd0        a0,d4,d5                ; Bwd0(addr0,dG,dH)
        adda.l      &inc,a1                 ; addr1+=inc
        Bwd1        a1,a0,d4,d5             ; Bwd1(addr1,addr0,dG,dH)
        adda.l      &inc,a0                 ; addr0+=inc
        dbf         &count,@do              ; while -1!=count
*
        endm
*-----------------------------------
HaarBackward    FUNC    EXPORT
*
*   d0 - spare, d1 - count1, d2 - inc2, d3 - inc1, d4 - dG, d5 - dH, d6 - loop1, d
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      $000C(a6),d3            ; inc=inc1
        movea.l     $0008(a6),a5            ; base=data
        move.l      $0010(a6),d6            ; loop1 (width/height)
        move.l      $0018(a6),d7            ; loop2 (height/width)
        move.l      $0014(a6),d2            ; inc2
        subq.l      #1,d7                   ; loop2-=1
        lsr.l       #1,d6                   ; loop1/=2
        subq.l      #1,d6                   ; loop1-=1
```

Engineering:KlicsCode:CompPict:Haar.a

```
@do     move.l      d6,d1                   ; count1=loop1
        Bwd         a5,d1,d3                ; Bwd(base,count,inc)
        adda.l      d2,a5                   ; base+=inc2
        dbf         d7,@do                  ; while -1!=--loop2
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*---------------------------------
HaarXTopBwd FUNC    EXPORT
*
        link        a6,#0                   ; no local variables
*
        movea.l     $0008(a6),a0            ; start
        move.l      $000C(a6),d3            ; area
        lsr.l       #1,d3                   ; area (long)
        subq.l      #1,d3                   ; area-=1
@do     move.l      (a0),d0                 ; d0=HG=*Y
        move.l      d0,d1                   ; d1=HG
        swap        d1                      ; d1=GH
        neg.w       d0                      ; d0=H(-G)
        add.l       d1,d0                   ; d0=01
        move.l      d0,(a0)+                ; *Y++=01
        dbf         d3,@do                  ; while -1!=--area
*
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*---------------------------------
HaarTopBwd  FUNC    EXPORT
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d6,-(a7)             ; store registers
*
        movea.l     $0008(a6),a0            ; startH
        movea.l     a0,a1                   ; startG
        move.l      $000C(a6),d6            ; height
        move.l      $0010(a6),d3            ; width
        move.l      d3,d6                   ; linelen=width
        add.l       d6,d6                   ; linelen (bytes)
        lsr.l       #1,d4                   ; height/=2
        lsr.l       #1,d3                   ; width/=2
        subq.l      #1,d4                   ; height-=1
        subq.l      #1,d3                   ; width-=1
@do1    adda.l      d6,a1                   ; startG+=linelen
        move.l      d3,d5                   ; linecount=width
@do2    move.l      (a0),d0                 ; d0=HAHB=*Y0
        move.l      (a1),d1                 ; d1=GAGB=*Y1
        move.l      d0,d2                   ; d2=HAHB
        add.l       d1,d0                   ; d0=0A0B
        sub.l       d1,d2                   ; d2=1A1B
*
        move.l      d0,d1                   ; d1=HG
        swap        d1                      ; d1=GH
        neg.w       d0                      ; d0=H(-G)
        add.l       d1,d0                   ; d0=01
        move.l      d0,(a0)+                ; *Y0++=0A0B
*
        move.l      d2,d1                   ; d1=HG
        swap        d1                      ; d1=GH
```

Engineering:KlicsCode:CompPict:Haar.a

```
        neg.w   =d2                     ; d2=H(-G)
        add.l   d1,d2                   ; d2=01
        move.l  d2,(a1)+                ; *Y1++=1A1B

        dbf     d5,@do2                 ; while -1!=--linecount
        move.l  a1,a0                   ; startH=startG
        dbf     d4,@do1                 ; while -1!=--height

        movem.l (a7)+,d4-d6             ; restore registers
        unlk    a6                      ; remove locals
        rts                             ; return

        ENDFUNC
;-----------------------------------
        END
```

Engineering:KlicsCode:CompPict:ConvolveSH3.c

```
/*********************************
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 *********************************/
/*
    2D wavelet transform convolver (fast hardware emulation)
    New improved wavelet coeffs : 11 19 5 3

    Optimized for speed:
        dirn - False
        src/dst octave == 0
*/

#define FwdS(addr0,dAG,dAH) \
    v=*(short *)addr0; \
    dAG=(v3=v+(vs=v<<1)); \
    dAG+=v+(vs<<=1); \
    dAH=v3+(vs<<=1); \
    dAH+=v3+(vs<<=1);

#define Fwd1(addr1,dAG,dAH,dBG,dBH) \
    v=*(short *)addr1; \
    dBG=(v3=v+(vs=v<<1)); \
    dAH+=v+(vs<<=1); \
    dBH=v3+(vs<<=1); \
    dAG-=v3+(vs<<=1);

#define Fwd2(addr2,addr1,addr0,dAG,dAH,dBG,dBH) \
    v=*(short *)addr2; \
    dAH-=(v3=v+(vs=v<<1)); \
    dBG+=v+(vs<<=1); \
    dAG+=v3+(vs<<=1); \
    dBH+=v3+(vs<<=1); \
    *(short *)addr0=(dAH+15)>>5; \
    *(short *)addr1=(dAG+15)>>5;

#define Fwd3(addr3,dAG,dAH,dBG,dBH) \
    v=*(short *)addr3; \
    dAG=(v3=v+(vs=v<<1)); \
    dBH+=v+(vs<<=1); \
    dAH=v3+(vs<<=1); \
    dBG-=v3+(vs<<=1);

#define Fwd0(addr0,addr3,addr2,dAG,dAH,dBG,dBH) \
    v=*(short *)addr0; \
    dBH-=(v3=v+(vs=v<<1)); \
    dAG+=v+(vs<<=1); \
    dBG+=v3+(vs<<=1); \
    dAH+=v3+(vs<<=1); \
    *(short *)addr2=(dBH+15)>>5; \
    *(short *)addr3=(dBG+15)>>5;

#define FwdE(addr3,addr2,dBG,dBH) \
    v=*(short *)addr3; \
    dBH+=(vs=v<<1); \
    dBG-=(vs<<2); \
    *(short *)addr2=(dBH+15)>>5; \
    *(short *)addr3=(dBG+15)>>5;
```

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```
#define Fwd(base,end,inc) \
    addr0=base; \
    addr3=addr0-(inc>>2); \
    addr2=addr3-(inc>>2); \
    addr1=addr2-(inc>>2); \
    FwdS(addr0,dAG,dAH); \
    addr1+=inc; \
    Fwd1(addr1,dAG,dAH,dBG,dBH); \
    addr2+=inc; \
    Fwd2(addr2,addr1,addr0,dAG,dAH,dBG,dBH); \
    addr3+=inc; \
    while(addr3<end) { \
        Fwd3(addr3,dAG,dAH,dBG,dBH); \
        addr0+=inc; \
        Fwd0(addr0,addr3,addr2,dAG,dAH,dBG,dBH); \
        addr1+=inc; \
        Fwd1(addr1,dAG,dAH,dBG,dBH); \
        addr2+=inc; \
        Fwd2(addr2,addr1,addr0,dAG,dAH,dBG,dBH); \
        addr3+=inc; \
    } \
    FwdE(addr3,addr2,dBG,dBH);

extern  void FASTFORWARD(char *data, long inc1, long end1, long inc2, char *end2);
extern  void HAARFORWARD(char *data, long inc1, long end1, long inc2, char *end2);

void    FastForward(char *data, long inc1, long end1, long inc2, char *end2)
{
    register short  v, vs, v3, dAG, dAH, dBG, dBH, inc;
    register char   *addr0, *addr1, *addr2, *addr3, *end;
    char    *base;

    inc=inc1;
    for(base=data;base<end2;base+=inc2) {
        end=base+end1;
        Fwd(base,end,inc);
    }
}


void    Daub4Forward(short *data, int size[2], int oct_dst);
{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    for(oct=0;oct!=oct_dst;oct++) {
        long    cinc=2<<oct, cinc4=cinc<<2,
                rinc=size[0]<<oct+1, rinc4=rinc<<2; /* col and row increments in t

        FASTFORWARD((char *)data,cinc4,width-cinc,rinc,top);
        FASTFORWARD((char *)data,rinc4,area-rinc,cinc,left);
    }
}

void    HaarForward(short *data, int size[2], int oct_dst)
{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    for(oct=0;oct!=oct_dst;oct++) {
        long    cinc=2<<oct, cinc2=cinc<<1,
```

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```
        rinc=size[0]<<oct+1, rinc2=rinc<<1; /* col and row increments in t

    HAARFORWARD((char *)data,cinc2,width,rinc,top);
    HAARFORWARD((char *)data,rinc2,area,cinc,left);
}

void    HybridForward(short *data, int size[2], int oct_dst)
{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    HAARFORWARD((char *)data,4,width,size[0]<<1,top);
    HAARFORWARD((char *)data,size[0]<<2,area,2,left);
    for(oct=1;oct!=oct_dst;oct++) {
        long    cinc=2<<oct, cinc4=cinc<<2,
                rinc=size[0]<<oct+1, rinc4=rinc<<2; /* col and row increments in t

        FASTFORWARD((char *)data,cinc4,width-cinc,rinc,top);
        FASTFORWARD((char *)data,rinc4,area-rinc,cinc,left);
    }
}

#define BwdS0(addr0,dAG,dAH,dBH) \
    v=*(short *)addr0; \
    dAG= -(v3=v+(vs=v<<1)); \
    dAH=v+(vs<<=1); \
    dBH=vs<<1; \

#define BwdS1(addr1,addr0,dAG,dAH,dBH) \
    v=*(short *)addr1; \
    dBH+=(vs=v<<1); \
    v3=vs+v; \
    dAG+=v3+(vs<<=2); \
    dAH-=v3+(vs<<=1); \
    *(short *)addr0=(dBH+3)>>3;

#define Bwd2(addr2,dAG,dAH,dBG,dBH) \
    v=*(short *)addr2; \
    dBG= -(v3=v+(vs=v<<1)); \
    dBH=v+(vs<<=1); \
    dAH+=v3+(vs<<=1); \
    dAG+=v3+(vs<<=1);

#define Bwd3(addr3,addr2,addr1,dAG,dAH,dBG,dBH) \
    v=*(short *)addr3; \
    dAH+=(v3=v+(vs=v<<1)); \
    dAG+=v+(vs<<=1); \
    dBG+=v3+(vs<<=1); \
    dBH-=v3+(vs<<=1); \
    *(short *)addr1=(dAH+7)>>4; \
    *(short *)addr2=(dAG+7)>>4;

#define Bwd0(addr0,dAG,dAH,dBG,dBH) \
    v=*(short *)addr0; \
    dAG= -(v3=v+(vs=v<<1)); \
    dAH=v+(vs<<=1); \
    dBH+=v3+(vs<<=1); \
    dBG+=v3+(vs<<=1);

#define Bwd1(addr1,addr0,addr3,dAG,dAH,dBG,dBH) \
    v=*(short *)addr1; \
```

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```
    dBH+=(v)=v+(vs=v<<1)); \
    dBG+=v+(vs<<=1); \
    dAG+=v3+(vs<<=1); \
    dAH-=v3+(vs<<=1); \
    *(short *)addr3=(dBH+7)>>4; \
    *(short *)addr0=(dBG+7)>>4;

#define BwdE2(addr2,dAG,dAH,dBH) \
    v=*(short *)addr2; \
    v3=v+(vs=v<<1); \
    dBH=(vs<<=2); \
    dAH+=v3+vs; \
    dAG+=v3+(vs<<=1);

#define BwdE3(addr3,addr2,addr1,dAG,dAH,dBH) \
    v=*(short *)addr3; \
    dAH+=(v3=v+(vs=v<<1)); \
    dAG+=v+(vs<<=1); \
    dBH-=v3+(vs<<=1); \
    dBH-=v3+(vs<<=1); \
    *(short *)addr1=(dAH+7)>>4; \
    *(short *)addr2=(dAG+7)>>4; \
    *(short *)addr3=(dBH+3)>>3;

#define Bwd(base,end,inc) \
    addr0=base; \
    addr3=addr0-(inc>>2); \
    addr2=addr3-(inc>>2); \
    addr1=addr2-(inc>>2); \
    BwdS0(addr0,dAG,dAH,dBH); \
    addr1+=inc; \
    BwdS1(addr1,addr0,dAG,dAH,dBH); \
    addr2+=inc; \
    while(addr2<end) { \
        Bwd2(addr2,dAG,dAH,dBG,dBH); \
        addr3+=inc; \
        Bwd3(addr3,addr2,addr1,dAG,dAH,dBG,dBH); \
        addr0+=inc; \
        Bwd0(addr0,dAG,dAH,dBG,dBH); \
        addr1+=inc; \
        Bwd1(addr1,addr0,addr3,dAG,dAH,dBG,dBH); \
        addr2+=inc; \
    } \
    BwdE2(addr2,dAG,dAH,dBH); \
    addr3+=inc; \
    BwdE3(addr3,addr2,addr1,dAG,dAH,dBH);

extern void FASTBACKWARD(char *data, long inc1, long loop1, long inc2, char *end2)
extern void HAARBACKWARD(char *data, long inc1, long loop1, long inc2, long loop2)
extern void HAARTOPBWD(char *data,long height,long width);
/* extern void  HAARXTOPBWD(char *data,long area);*/

void    FastBackward(char *data, long inc1, long end1, long inc2, char *end2)
{
    register short  v, vs, v3, dAG, dAH, dBG, dBH, inc;
    register char   *addr0, *addr1, *addr2, *addr3, *end;
    char    *base;

    inc=inc1;
    for(base=data;base<end2;base+=inc2) {
        end=base+end1;
        Bwd(base,end,inc);
    }
```

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```
}

void    Daub4Backward(short *data,int size[2],int oct_src)
{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    for(oct=oct_src-1;oct>=0;oct--) {
        long    cinc=2<<oct, cinc4=cinc<<2,
                rinc=size[0]<<oct+1, rinc4=rinc<<2; /* col and row increments in t

        FASTBACKWARD((char *)data,rinc4,area-(rinc<<1),cinc,left);
        FASTBACKWARD((char *)data,cinc4,width-(cinc<<1),rinc,top);
    }
}

void    HaarBackward(data,size,oct_src)

short   *data;
int     size[2], oct_src;

{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    for(oct=oct_src-1;oct>0;oct--) {
        long    cinc=2<<oct, cinc2=cinc<<1,
                rinc=size[0]<<oct+1, rinc2=rinc<<1; /* col and row increments in t

        HAARBACKWARD((char *)data,rinc2,size[1]>>oct,cinc,size[0]>>oct);
        HAARBACKWARD((char *)data,cinc2,size[0]>>oct,rinc,size[1]>>oct);
    }
    HAARTOPBWD((char *)data,size[1],size[0]);
/*  HAARXTOPBWD((char *)data,area>>1);*/
}

void    HybridBackward(data,size,oct_src)

short   *data;
int     size[2], oct_src;

{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    for(oct=oct_src-1;oct>0;oct--) {
        long    cinc=2<<oct, cinc4=cinc<<2,
                rinc=size[0]<<oct+1, rinc4=rinc<<2; /* col and row increments in t

        FASTBACKWARD((char *)data,rinc4,area-(rinc<<1),cinc,left);
        FASTBACKWARD((char *)data,cinc4,width-(cinc<<1),rinc,top);
    }
    HAARTOPBWD((char *)data,size[1],size[0]);
/*  HAARXTOPBWD((char *)data,area>>1);*/
}
```

Engineering:KlicsCode:CompPict:ConvolveSH3.a

```
*-----------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*-----------------------------------
*
*   68000 FastForward/Backward code
*
*-----------------------------------
        seg         'klics'

        macro
        FwdStart    &addr0,&dAG,&dAH
*
        move.w      (&addr0),d0     ; v=*(short *)addr0
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1
        move.w      d1,d2           ; v3=vs
        add.w       d0,d2           ; v3=vs+v
        move.w      d2,&dAG         ; dAG=v3
        add.w       d1,d1           ; vs<<=1
        add.w       d0,&dAG         ; dAG+=v
        add.w       d1,&dAG         ; dAG+=vs
        move.w      d2,&dAH         ; dAH=v3
        add.w       d1,d1           ; vs<<=1
        add.w       d1,&dAH         ; dAH+=vs
        add.w       d2,&dAH         ; dAH+=v3
        add.w       d1,d1           ; vs<<=1
        add.w       d1,&dAH         ; dAH+=vs
*
        endm
*-----------------------------------
        macro
        FwdOdd      &addr1,&dAG,&dAH,&dBG,&dBH
*
        move.w      (&addr1),d0     ; v=*(short *)addr1
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1
        move.w      d1,d2           ; v3=vs
        add.w       d0,d2           ; v3=vs+v
        move.w      d2,&dBG         ; dBG=v3
        add.w       d1,d1           ; vs<<=1
        add.w       d0,&dAH         ; dAH+=v
        add.w       d1,&dAH         ; dAH+=vs
        move.w      d2,&dBH         ; dBH=v3
        add.w       d1,d1           ; vs<<=1
        add.w       d1,&dBH         ; dBH+=vs
        sub.w       d2,&dAG         ; dAG-=v3
        add.w       d1,d1           ; vs<<=1
        sub.w       d1,&dAG         ; dAG-=vs
*
        endm
*-----------------------------------
        macro
        FwdEven     &addr2,&addr1,&addr0,&dAG,&dAH,&dBG,&dBH
*
        move.w      (&addr2),d0     ; v=*(short *)addr2
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1
        move.w      d1,d2           ; v3=vs
```

Engineering:KlicsCode:CompPict:ConvolveSH3.a

```
        add.w       d0,d2           ; v2=vs+v
        sub.w       d2,&dAH         ; dAH-=v2
        add.w       d1,d1           ; vs<<=1
        add.w       d0,&dBG         ; dBG+=v
        add.w       d1,&dBG         ; dBG+=vs
        add.w       d2,&dAG         ; dAG+=v2
        add.w       d1,d1           ; vs<<=1
        add.w       d1,&dAG         ; dAG+=vs
        add.w       d2,&dBH         ; dBH+=v2
        add.w       d1,d1           ; vs<<=1
        add.w       d1,&dBH         ; dBH+=vs
        clr.w       d0              ; d0=0
        asr.w       #5,&dAH         ; dAH>>=5
        addx.w      d0,&dAH         ; round dAH
        asr.w       #5,&dAG         ; dAG>>=5
        addx.w      d0,&dAG         ; round dAG
        move.w      &dAH,(&addr0)   ; *(short *)addr0=dAH
        move.w      &dAG,(&addr1)   ; *(short *)addr1=dAG
*
        mend
*-------------------------------
        macro
        FwdEnd  &addr3,&addr2,&dBG,&dBH
*
        move.w      (&addr3),d0     ; v=*(short *)addr3
        add.w       d0,d0           ; v<<=1
        add.w       d0,&dBH         ; dBH+=v
        lsl.w       #2,d0           ; v<<=2
        sub.w       d0,&dBG         ; dBG-=v
        clr.w       d0              ; d0=0
        asr.w       #5,&dBH         ; dBH>>=5
        addx.w      d0,&dBH         ; round dBH
        asr.w       #5,&dBG         ; dBG>>=5
        addx.w      d0,&dBG         ; round dBG
        move.w      &dBH,(&addr2)   ; *(short *)addr2=dBH
        move.w      &dBG,(&addr3)   ; *(short *)addr3=dBG
*
        endm.
*-------------------------------
        macro
        Fwd         &base,&end,&inc
*
        movea.l     &base,a0                ; addr0=base
        move.l      &inc,d0                 ; d0=inc
        asr.l       #2,d0                   ; d0=inc>>2
        movea.l     a0,a3                   ; addr3=addr0
        suba.l      d0,a3                   ; addr3-=(inc>>2)
        movea.l     a3,a2                   ; addr2=addr3
        suba.l      d0,a2                   ; addr2-=(inc>>2)
        movea.l     a2,a1                   ; addr1=addr2
        suba.l      d0,a1                   ; addr1-=(inc>>2)
        FwdStart    a0,d4,d5                ; FwdStart(addr0,dAG,dAH)
        adda.l      &inc,a1                 ; addr1+=inc
        FwdOdd      a1,d4,d5,d6,d7          ; FwdOdd(addr1,dAG,dAH,dBG,dBH)
        adda.l      &inc,a2                 ; addr2+=inc
        FwdEven     a2,a1,a0,d4,d5,d6,d7    ; FwdEven(addr2,addr1,addr0,dAG,dAH,dB
        adda.l      &inc,a3                 ; addr3+=inc
@do     FwdOdd      a3,d6,d7,d4,d5          ; FwdOdd(addr3,dBG,dBH,dAG,dAH)
        adda.l      &inc,a0                 ; addr0+=inc
        FwdEven     a0,a3,a2,d6,d7,d4,d5    ; FwdEven(addr0,addr3,addr2,dBG,dBH,dA
        adda.l      &inc,a1                 ; addr1+=inc
        FwdOdd      a1,d4,d5,d6,d7          ; FwdOdd(addr1,dAG,dAH,dBG,dBH)
        adda.l      &inc,a2                 ; addr2+=inc
```

```
                    Engineering:KlicsCode:CompPict:ConvolveSH3.a
                    =
        FwdEven     a2,a1,a0,d4,d5,d6,d7    ; FwdEven(addr2,addr1,addr0,dAG,dAH,dB
        adda.l      &inc,a3                 ; addr3+=inc
        cmpa.l      a3,&end                 ; addr3<end
        bgt.w       @do                     ; while
        FwdEnd      a3,a2,d6,d7             ; FwdEnd(addr3,addr2,dBG,dBH)
*
        endm
*-----------------------------------
FastForward FUNC    EXPORT
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      $000C(a6),d3            ; inc=inc1
        movea.l     $0008(a6),a5            ; base=data
@do     movea.l     a5,a4                   ; end=base
        adda.l      $0010(a6),a4            ; end+=end1
        Fwd         a5,a4,d3                ; Fwd(base,end,inc)
        adda.l      $0014(a6),a5            ; base+=inc2
        cmpa.l      $0018(a6),a5            ; end2>base
        blt.w       @do                     ; for
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-----------------------------------
        macro
        BwdStart0   &addr0,&dAG,&dAH,&dBH
*
        move.w      (&addr0),d0     ; v=*(short *)addr0
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1 (vs=2v)
        add.w       d1,d0           ; v+=vs (v=3v)
        move.w      d0,&dAG         ; dAG=v3
        neg.w       &dAG            ; dAG= -dAG
        move.w      d0,&dAH         ; dAH=v
        add.w       d1,&dAH         ; dAH+=vs
        lsl.w       #2,d1           ; vs<<=2 (vs=8v)
        move.w      d1,&dBH         ; dBH=vs
*
        endm
*-----------------------------------
        macro
        BwdStart1   &addr1,&addr0,&dAG,&dAH,&dBH
*
        move.w      (&addr1),d0     ; v=*(short *)addr1
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1
        add.w       d1,&dBH         ; dBH+=vs
        add.w       d1,d0           ; v+=vs  (v=3v)
        lsl.l       #2,d1           ; vs<<=2 (vs=8v)
        add.w       d1,d0           ; v+=vs (v=11v)
        add.w       d0,&dAG         ; dAG+=v
        add.w       d1,d0           ; v+=vs (v=19v)
        sub.w       d0,&dAH         ; dAH-=v
*       clr.w       d0              ; d0=0
        asr.w       #3,&dBH         ; dBH>>=3
*       addx.w      d0,&dBH         ; round dBH
        move.w      &dBH,(&addr0)   ; *(short *)addr0=dBH
*
        endm
```

```
                Engineering:KlicsCode:CompPict:ConvolveSH3.a
                =
*---------------------------------
        macro
        BwdEven &addr2,&dAG,&dAH,&dBG,&dBH
*
        move.w      (&addr2),d0     ; v=*(short *)addr2
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1 (vs=2v)
        add.w       d1,d0           ; v+=vs  (v=3v)
        move.w      d0,&dBG         ; dBG=v
        neg.w       &dBG            ; dBG= -dBG
        move.w      d0,&dBH         ; dBH=v
        add.w       d1,&dBH         ; dBH+=vs
        lsl.w       #2,d1           ; vs<<=2 (vs=8v)
        add.w       d1,d0           ; v+=vs (v=11v)
        add.w       d0,&dAH         ; dAH+=v
        add.w       d1,d0           ; v+=vs (v=19v)
        add.w       d0,&dAG         ; dAG+=v
*
        endm
*---------------------------------
        macro
        BwdOdd      &addr3,&addr2,&addr1,&dAG,&dAH,&dBG,&dBH
*
        move.w      (&addr3),d0     ; v=*(short *)addr3
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1 (vs=2v)
        add.w       d1,d0           ; v+=vs  (v=3v)
        add.w       d0,&dAH         ; dAH+=v
        add.w       d0,&dAG         ; dAG+=v
        add.w       d1,&dAG         ; dAG+=vs
        lsl.w       #2,d1           ; vs<<=2 (vs=8v)
        add.w       d1,d0           ; v+=vs (v=11v)
        add.w       d0,&dBG         ; dBG+=v
        add.w       d1,d0           ; v+=vs (v=19v)
        sub.w       d0,&dBH         ; dBH-=v
*       clr.w       d0              ; d0=0
        asr.w       #4,&dAH         ; dAH>>=4
*       addx.w      d0,&dAH         ; round dAH
        move.w      &dAH,(&addr1)   ; *(short *)addr1=dAH
        asr.w       #4,&dAG         ; dAG>>=4
*       addx.w      d0,&dAG         ; round dAG
        move.w      &dAG,(&addr2)   ; *(short *)addr2=dAG
*
        endm
*---------------------------------
        macro
        BwdEnd2     &addr2,&dAG,&dAH,&dBH
*
        move.w      (&addr2),d0     ; v=*(short *)addr2
        move.w      d0,d1           ; vs=v
        add.w       d1,d1           ; vs<<=1 (vs=2v)
        add.w       d1,d0           ; v+=vs  (v=3v)
        lsl.w       #2,d1           ; vs<<=2 (vs=8v)
        move.w      d1,&dBH         ; dBH=vs
        add.w       d1,d0           ; v+=vs (v=11v)
        add.w       d0,&dAH         ; dAH+=v
        add.w       d1,d0           ; v+=vs (v=19v)
        add.w       d0,&dAG         ; dAG+=v
*
        endm
*---------------------------------
        macro
        BwdEnd1     &addr2,&addr1,&dAG,&dAH,&dBH
```

Engineering:KiicsCcde:CompPict:CcnvolveSH3.a

```
*                    >
          move.w      (&addr3),d0      ; v=*(short *)addr3
          move.w      d0,d1            ; vs=v
          add.w       d1,d1            ; vs<<=1 (vs=2v)
          add.w       d1,d0            ; v+=vs  (v=3v)
          add.w       d0,&dAH          ; dAH+=v
          add.w       d0,&dAG          ; dAG+=v
          add.w       d1,&dAG          ; dAG+=vs
          add.w       d1,&dBH          ; dBH+=vs
          lsl.l       #4,d1            ; vs<<=4  (v=32v)
          sub.w       d1,&dBH          ; dBH-=vs
*         clr.w       d0               ; d0=0
          asr.w       #4,&dAH          ; dAH>>=4
*         addx.w      d0,&dAH          ; round dAH
          move.w      &dAH,(&addr1)    ; *(short *)addr1=dAH
          asr.w       #4,&dAG          ; dAG>>=4
*         addx.w      d0,&dAG          ; round dAG
          move.w      &dAG,(&addr2)    ; *(short *)addr2=dAG
          asr.w       #3,&dBH          ; dBH>>=3
*         addx.w      d0,&dBH          ; round dBH
          move.w      &dBH,(&addr3)    ; *(short *)addr3=dBH
*
          endm
*---------------------------------
          macro
          Bwd         &base,&end,&inc
*
          movea.l     &base,a0              ; addr0=base
          move.l      &inc,d0               ; d0=inc
          asr.l       #2,d0                 ; d0=inc>>2
          movea.l     a0,a3                 ; addr3=addr0
          suba.l      d0,a3                 ; addr3-=(inc>>2)
          movea.l     a3,a2                 ; addr2=addr3
          suba.l      d0,a2                 ; addr2-=(inc>>2)
          movea.l     a2,a1                 ; addr1=addr2
          suba.l      d0,a1                 ; addr1-=(inc>>2)
          BwdStart0   a0,d4,d5,d7           ; BwdStart0(addr0,dAG,dAH,dBH)
          adda.l      &inc,a1               ; addr1+=inc
          BwdStart1   a1,a0,d4,d5,d7        ; BwdStart1(addr1,addr0,dAG,dAH,dBH)
          adda.l      &inc,a2               ; addr2+=inc
@do       BwdEven     a2,d4,d5,d6,d7        ; BwdEven(addr2,dAG,dAH,dBG,dBH)
          adda.l      &inc,a3               ; addr3+=inc
          BwdOdd      a3,a2,a1,d4,d5,d6,d7  ; BwdOdd(addr3,addr2,addr1,dAG,dAH,dBG
          adda.l      &inc,a0               ; addr0+=inc
          BwdEven     a0,d6,d7,d4,d5        ; BwdEven(addr0,dBG,dBH,dAG,dAH)
          adda.l      &inc,a1               ; addr1+=inc
          BwdOdd      a1,a0,a3,d6,d7,d4,d5  ; BwdOdd(addr1,addr0,addr3,dBG,dBH,dAG
          adda.l      &inc,a2               ; addr2+=inc
          cmpa.l      a2,&end               ; addr2<end
          bgt         @do                   ; while
          BwdEnd2     a2,d4,d5,d7           ; BwdEnd2(addr2,dAG,dAH,dBH)
          adda.l      &inc,a3               ; addr3+=inc
          BwdEnd3     a3,a2,a1,d4,d5,d7     ; BwdEnd3(addr3,addr2,addr1,dAG,dAH,dB
*
          endm
*---------------------------------
FastBackward    FUNC    EXPORT
*
          link        a6,#0                 ; no local variables
          movem.l     d4-d7/a3-a5,-(a7)     ; store registers
*
          move.l      $000C(a6),d3          ; inc=inc1
          movea.l     $0008(a6),a5          ; base=data
```

```
                    Engineering:KlicsCode:CompPict:ConvolveSH3.a
                    ➡
@do     movea.l     a5,a4                   ; end=base
        adda.l      $0010(a6),a4            ; end+=end1
        Bwd         a5,a4,d3                ; Bwd(base,end,inc)
        adda.l      $0014(a6),a5            ; base+=inc2
        cmpa.l      $0018(a6),a5            ; end2>base
        blt.w       @do                     ; for
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-------------------------------
        END
```

Engineering:KLicsCode:CompPict:Colour.c

```
/*****************************
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 *****************************/
/*
 *  Test versions of colour space conversions in C
 */

#include <Memory.h>
#include <QuickDraw.h>

#define NewPointer(ptr,type,size) \
    saveZone=GetZone(); \
    SetZone(SystemZone()); \
    if (nil==(ptr=(type)NewPtr(size))) { \
        SetZone(ApplicZone()); \
        if (nil==(ptr=(type)NewPtr(size))) { \
            SetZone(saveZone); \
            return(MemoryError()); \
        } \
    } \
    SetZone(saveZone);

typedef union {
    long    pixel;
    char    rgb[4];
} Pixel;

/* Special YUV space version */
#define rgb_yuv(pixmap,Yc) \
    pixel.pixel=0x808080^*pixmap++; \
    r=(short)pixel.rgb[1]; \
    g=(short)pixel.rgb[2]; g+=g; \
    b=(short)pixel.rgb[3]; \
    Y=(b<<3)-b; \
    g+=r; \
    Y+=g+g+g; \
    Y>>=4; \
    Y+=g; \
    *Yc++=Y; \
    Y>>=2; \
    U+=b-Y; \
    V+=r-Y;

#define limit(Y,low,high) \
    Y<(low<<2)?low<<2:Y>(high<<2)?high<<2:Y

/* Standard YUV space version - Bt294 CR07(0) mode limiting */
#define rgb_yuv32(pixmap,Yc) \
    pixel.pixel=0x808080^*pixmap++; \
    r=(long)pixel.rgb[1]; \
    g=(long)pixel.rgb[2]; \
    b=(long)pixel.rgb[3]; \
    Y= (306*r + 601*g + 117*b)>>8; \
    *Yc++ = limit(Y,16-128,235-128); \
    U+= (512*r - 429*g - 83*b)>>8; \
    V+= (-173*r - 339*g + 512*b)>>8;

void    RGB2YUV32(long *pixmap, short *Yc, short *Uc, short *Vc, int area, int wid
```

Engineering:KlicsCode:CompPict:Colour.c

```
    long    *pixmap2=pixmap+cols, *row, *end=pixmap+area;
    short   *Yc2=Yc+width;

    while(pixmap<end) {
        row=pixmap+width;
        while(pixmap<row) {
            Pixel   pixel;
            long    r,g,b,Y,U=0,V=0;

            rgb_yuv32(pixmap,Yc);
            rgb_yuv32(pixmap,Yc);
            rgb_yuv32(pixmap2,Yc2);
            rgb_yuv32(pixmap2,Yc2);
            U>>=2;
            V>>=2;
            *Uc++=limit(U,16-128,240-128);
            *Vc++=limit(V,16-128,240-128);
        }
        pixmap+=cols+cols-width;
        pixmap2+=cols+cols-width;
        Yc+=width;
        Yc2+=width;
    }
}

typedef struct {
    short   ry, rv, by, bu;
} RGB_Tab;

OSErr RGBTable(long **tab)
{
    RGB_Tab *table;
    int     i;
    THz     saveZone;

    NewPointer(table,RGB_Tab*,256*sizeof(RGB_Tab));
    *tab=(long *)table;
    for(i=0;i<128;i++) {
        table[i].ry=306*i>>8;
        table[i].rv=173*i>>8;
        table[i].by=117*i>>8;
        table[i].bu=83*i>>8;
    }
    for(i=128;i<256;i++) {
        table[i].ry=306*(i-256)>>8;
        table[i].rv=173*(i-256)>>8;
        table[i].by=117*(i-256)>>8;
        table[i].bu=83*(i-256)>>8;
    }
    return(noErr);
}

typedef struct {
    short   ru, gu, bv, gv;
} UV32_Tab;

UV32_Tab *UV32_Table()
{
    UV32_Tab    *table;
    int     i;

    table=(UV32_Tab *)NewPtr(256*sizeof(UV32_Tab));
```

Engineering:KickCode:CompPict:Colour.c

```
    for(i=0;i<128;i++) {
        table[i].ru=128+(1436*i>>10);
        table[i].gu=128+(-731*i>>10);
        table[i].bv=128+(1815*i>>10);
        table[i].gv=-352*i>>10;
    }
    for(i=128;i<256;i++) {
        table[i].ru=128+(1436*(i-256)>>10);
        table[i].gu=128+(-731*(i-256)>>10);
        table[i].bv=128+(1815*(i-256)>>10);
        table[i].gv=-352*(i-256)>>10;
    }
    return(table);
}

typedef struct {
    long    u, v;
} UV32Tab;

OSErr   UV32Table(long **tab)
{
    long    *ytab;
    UV32Tab *uvtab;
    int     i;
    THz     saveZone;

    NewPointer(*tab,long*,512*sizeof(long)+512*sizeof(UV32Tab));
    ytab=*tab;
    uvtab=(UV32Tab*)&ytab[512];
    for(i=-256;i<256;i++) {
        long    yyy, sp;

        sp=0x000000fe&(i<-128?0:i>127?255:i+128);
        yyy=sp; yyy<<=8;
        yyy|=sp; yyy<<=8;
        yyy|=sp;
        ytab[0x000001ff&i]=yyy;
    }
    for(i=-256;i<256;i++) {
        long    ru,gu,bv,gv;

        ru=0xfffffffe & (1436*i>>10);
        gu=0x000001fe & (-731*i>>10);
        bv=0x000001fe & (1815*i>>10);
        gv=0x000001fe & (-352*i>>10);

        uvtab[0x000001FF&i].u=((ru<<8)|gu)<<8;
        uvtab[0x000001FF&i].v=(gv<<8)|bv;
    }
    return(noErr);
}

typedef struct {
    short   u, v;
} UV16Tab;

OSErr   UV16Table(long **tab)
{
    short   *ytab;
    UV16Tab *uvtab;
    int     i;
    THz     saveZone;
```

Engineering:KiicsCode:CompPict:Colour.c

```
    NewPointer(*tab,long*,512*sizeof(short)+512*sizeof(UV16Tab));
    ytab=*(short **)tab;
    uvtab=(UV16Tab*)&ytab[512];
    for(i=-256;i<256;i++) {
        long    yyy, sp;

        sp=0x000001e&((i<-128?0:i>127?255:i+128)>>3);
        yyy=sp; yyy<<=5;
        yyy|=sp; yyy<<=5;
        yyy|=sp;
        ytab[0x000001ff&i]=yyy;
    }
    for(i=-256;i<256;i++) {
        long    ru,gu,bv,gv;

        ru=0xfffffffe & (1436*i>>13);
        gu=0x0000003e & (-731*i>>13);
        bv=0x0000003e & (1815*i>>13);
        gv=0x0000003e & (-352*i>>13);

        uvtab[0x000001FF&i].u=((ru<<5)|gu)<<5;
        uvtab[0x000001FF&i].v=(gv<<5)|bv;
    }
    return(noErr);
}

#define over(val) \
    ((0xFF00&(val)) == 0)?(char)val:val<0?0:255

/* Standard YUV space version */
#define yuv_rgb32(pixmap,Yc) \
    Y=(*Yc++)>>2; \
    pixel.rgb[1]=over(Y+r); \
    pixel.rgb[2]=over(Y+g); \
    pixel.rgb[3]=over(Y+b); \
    *pixmap++=pixel.pixel;


void    YUV2RGB32(long *pixmap, short *Yc, short *Uc, short *Vc, int area, int wid
{
    long    *pixmap2=pixmap+cols, *row, *end=pixmap+area;
    short   *Yc2=Yc+width;

    while(pixmap<end) {
        row=pixmap+width;
        while(pixmap<row) {
            Pixel   pixel;
            long    r,g,b,Y,U,V;

            U=(*Uc++)>>2;
            V=(*Vc++)>>2;
            r=128+(1436*U>>10);
            g=128+(-731*U - 352*V>>10);
            b=128+(1815*V>>10);

            yuv_rgb32(pixmap,Yc);
            yuv_rgb32(pixmap,Yc);
            yuv_rgb32(pixmap2,Yc2);
            yuv_rgb32(pixmap2,Yc2);
        }
        pixmap+=cols+cols-width;
        pixmap2+=cols+cols-width;
        Yc+=width;
```

Engineering:KlicsCode:CompPict:Colour.c

```
        Yc2+=width;
    }
}

#define rgb32_yuv(pixmap,Yc) \
    pixel.pixel=0x808080^*pixmap++; \
    r=pixel.rgb[1]; \
    g=pixel.rgb[2]; \
    b=pixel.rgb[3]; \
    Y= (table[0xFF&r].ry + (g<<2)-table[0xFF&g].ry-table[0xFF&g].by + table[0xFF&b
    *Yc++ = limit(Y,16-128,235-128); \
    U+= (r<<1) -g -table[0xFF&g].rv - table[0xFF&b].bu; \
    V+= (b<<1) -g -table[0xFF&r].rv - table[0xFF&g].bu;

void    RGB32YUV(RGB_Tab *table,long *pixmap, short *Yc, short *Uc, short *Vc, int
{
    long    *pixmap2=pixmap+cols, *row, *end=pixmap+area;
    short   *Yc2=Yc+width;

    while(pixmap<end) {
        row=pixmap+width;
        while(pixmap<row) {
            Pixel   pixel;
            long    r,g,b,Y,U=0,V=0;

/*          rgb32_yuv(pixmap,Yc);*/
            pixel.pixel=0x808080^*pixmap++;
            r=pixel.rgb[1];
            g=pixel.rgb[2];
            b=pixel.rgb[3];
            Y= (table[0xFF&r].ry + (g<<2)-table[0xFF&g].ry-table[0xFF&g].by + tabl
            *Yc++ = limit(Y,16-128,235-128);
            U+= (r<<1) -g -table[0xFF&g].rv - table[0xFF&b].bu;
            V+= (b<<1) -g -table[0xFF&r].rv - table[0xFF&g].bu;

            rgb32_yuv(pixmap,Yc);
            rgb32_yuv(pixmap2,Yc2);
            rgb32_yuv(pixmap2,Yc2);
            U>>=2;
            V>>=2;
            *Uc++=limit(U,16-128,240-128);
            *Vc++=limit(V,16-128,240-128);
        }
        pixmap+=cols+cols-width;
        pixmap2+=cols+cols-width;
        Yc+=width;
        Yc2+=width;
    }
}


#define yuv_rgb32x2(pixmap,Y) \
    pixel.rgb[1]=over(Y+r); \
    pixel.rgb[2]=over(Y+g); \
    pixel.rgb[3]=over(Y+b); \
    pixmap[cols]=pixel.pixel; \
    *pixmap++=pixel.pixel;


void    YUV2RGB32x2(UV32_Tab *table,long *pixmap, short *Yc, short *Uc, short *Vc,
{
    long    *pixmap2=pixmap+2*cols, *row, *end=pixmap+area;
    short   *Yc2=Yc+width;
```

Engineering:KlicsCode:CompPict:Colour.c

```
    while(pixmap<end) {
        long    Yold=*Yc>>2, Yold2=*Yc2>>2;

        row=pixmap+width*2;
        while(pixmap<row) {
            Pixel   pixel;
            long    r,g,b,Y,U,V;

            U=0x00FF&((*Uc++)>>2);
            V=0x00FF&((*Vc++)>>2);
            r=table[U].ru;
            g=table[U].gu+table[V].gv;
            b=table[V].bv;

            Y=(*Yc++)>>2;
            Yold=(Y+Yold)>>1;
            yuv_rgb32x2(pixmap,Yold);

            Yold=Y;
            yuv_rgb32x2(pixmap,Yold);

            Y=(*Yc++)>>2;
            Yold=(Y+Yold)>>1;
            yuv_rgb32x2(pixmap,Yold);

            Yold=Y;
            yuv_rgb32x2(pixmap,Yold);

            Y=(*Yc2++)>>2;
            Yold2=(Y+Yold2)>>1;
            yuv_rgb32x2(pixmap2,Yold2);

            Yold2=Y;
            yuv_rgb32x2(pixmap2,Yold2);

            Y=(*Yc2++)>>2;
            Yold2=(Y+Yold2)>>1;
            yuv_rgb32x2(pixmap2,Yold2);

            Yold2=Y;
            yuv_rgb32x2(pixmap2,Yold2);
        }
        pixmap+=4*cols-2*width;
        pixmap2+=4*cols-2*width;
        Yc+=width;
        Yc2+=width;
    }
}

#define yuv_rgb8(pixel,Yc,index,dith) \
    Y=*Yc++; \
    Y<<=3; \
    Y&= 0x3F00; \
    Y|= U; \
    pixel.rgb[index]=table[Y].rgb[dith];

void    YUV2RGB8(Pixel *table,long *pixmap, short *Yc, short *Uc, short *Vc, int a
{
    long    *pixmap2=pixmap+cols/4, *row, *end=pixmap+area/4;
    short   *Yc2=Yc+width;

    while(pixmap<end) {
```

Engineering:KlicsCode:CompPict:Colour.c

```
        row=pixmap+width/4;
        while(pixmap<row) {
            Pixel   pixel, pixel2;
            long    Y,U,V;

            U=*Uc++;
            V=*Vc++;
            U>>=2;
            V>>=6;
            U= (U&0xF0) | (V&0x0F);

            yuv_rgb8(pixel,Yc,0,3);
            yuv_rgb8(pixel,Yc,1,0);
            yuv_rgb8(pixel2,Yc2,0,1);
            yuv_rgb8(pixel2,Yc2,1,2);

            U=*Uc++;
            V=*Vc++;
            U>>=2;
            V>>=6;
            U= (U&0xF0) | (V&0x0F);

            yuv_rgb8(pixel,Yc,2,3);
            yuv_rgb8(pixel,Yc,3,0);
            yuv_rgb8(pixel2,Yc2,2,1);
            yuv_rgb8(pixel2,Yc2,3,2);

            *pixmap++=pixel.pixel;
            *pixmap2++=pixel2.pixel;
        }
        pixmap+=(cols+cols-width)/4;
        pixmap2+=(cols+cols-width)/4;
        Yc+=width;
        Yc2+=width;
    }
}

#define yuv_rgb8x2(pixel,pixel2,Y,index,dith,dith2) \
    Y&= 0x3F00; \
    Y|= U; \
    pixel.rgb[index]=table[Y].rgb[dith]; \
    pixel2.rgb[index]=table[Y].rgb[dith2];

void    YUV2RGB8x2(Pixel *table,long *pixmap, short *Yc, short *Uc, short *Vc, int
{
    long    *pixmap2=pixmap+cols/2, *row, *end=pixmap+area/4;
    short   *Yc2=Yc+width;

    while(pixmap<end) {
        long    Yold=*Yc<<3, Yold2=*Yc2<<3;

        row=pixmap+width/2;
        while(pixmap<row) {
            Pixel   pixel, pixel2, pixel3, pixel4;
            long    Y,U,V;

            U=*Uc++;
            V=*Vc++;
            U>>=2;
            V>>=6;
            U= (U&0x00F0) | (V&0x000F);

            Y=(*Yc++)<<3;
```

Engineering:KlicsCode:CompPict:Colour.c

```
            Yold=(Y+Yold)>>1;
            yuv_rgb8x2(pixel,pixel2,Y,0,3,1);

            Yold=Y;
            yuv_rgb8x2(pixel,pixel2,Y,1,0,2);
            Yold=Y;

            Y=(*Yc++)<<3;
            Yold=(Y+Yold)>>1;
            yuv_rgb8x2(pixel,pixel2,Y,2,3,1);

            Yold=Y;
            yuv_rgb8x2(pixel,pixel2,Y,3,0,2);
            Yold=Y;

            Y=(*Yc2++)<<3;
            Yold2=(Y+Yold2)>>1;
            yuv_rgb8x2(pixel3,pixel4,Y,0,3,1);

            Yold2=Y;
            yuv_rgb8x2(pixel3,pixel4,Y,1,0,2);
            Yold2=Y;

            Y=(*Yc2++)<<3;
            Yold2=(Y+Yold2)>>1;
            yuv_rgb8x2(pixel3,pixel4,Y,2,3,1);

            Yold2=Y;
            yuv_rgb8x2(pixel3,pixel4,Y,3,0,2);
            Yold2=Y;

            pixmap[cols/4]=pixel2.pixel;
            *pixmap++=pixel.pixel;

            pixmap2[cols/4]=pixel4.pixel;
            *pixmap2++=pixel3.pixel;
        }
        pixmap+=(cols+cols-width)/2;
        pixmap2+=(cols+cols-width)/2;
        Yc+=width;
        Yc2+=width;
    }
}

#define yuv_rgbTEST(pixel,index,Y) \
    rgb_col.red=(Y+r<<8); \
    rgb_col.green=(Y+g<<8); \
    rgb_col.blue=(Y+b<<8); \
    pixel.rgb[index]=Color2Index(&rgb_col);


void    YUV2RGBTEST(UV32_Tab *table,long *pixmap, short *Yc, short *Uc, short *Vc,
{
    long    *pixmap2=pixmap+cols/2, *row, *end=pixmap+area/4;
    short   *Yc2=Yc+width;

    while(pixmap<end) {
        long    Yold=*Yc<<3, Yold2=*Yc2<<3;

        row=pixmap+width/2;
        while(pixmap<row) {
            RGBColor    rgb_col;
            Pixel   pixel, pixel2;
```

Engineering:KlicsCode:CompPict:Colour.c

```
        long r,g,b,Y,U,V;

        U=0x00FF&((*Uc++)>>2);
        V=0x00FF&((*Vc++)>>2);
        r=table[U].ru;
        g=table[U].gu+table[V].gv;
        b=table[V].bv;

        Y=(*Yc++)>>2;
        Yold=(Y+Yold)>>1;
        rgb_col.red=(Yold+r<<8);
        rgb_col.green=(Yold+g<<8);
        rgb_col.blue=(Yold+b<<8);
        pixel.rgb[0]=Color2Index(&rgb_col);

        Yold=Y;
        yuv_rgbTEST(pixel,1,Yold);

        Y=(*Yc++)>>2;
        Yold=(Y+Yold)>>1;
        yuv_rgbTEST(pixel,2,Yold);

        Yold=Y;
        yuv_rgbTEST(pixel,3,Yold);

        Y=(*Yc2++)>>2;
        Yold2=(Y+Yold2)>>1;
        yuv_rgbTEST(pixel2,0,Yold2);

        Yold2=Y;
        yuv_rgbTEST(pixel2,1,Yold2);

        Y=(*Yc2++)>>2;
        Yold2=(Y+Yold2)>>1;
        yuv_rgbTEST(pixel2,2,Yold2);

        Yold2=Y;
        yuv_rgbTEST(pixel2,3,Yold2);

        pixmap[cols/4]=pixel.pixel;
        *pixmap++=pixel.pixel;

        pixmap2[cols/4]=pixel2.pixel;
        *pixmap2++=pixel2.pixel;
      }
      pixmap+=(cols+cols-width)/2;
      pixmap2+=(cols+cols-width)/2;
      Yc+=width;
      Yc2+=width;
    }
}
```

Engineering:KlicsCode:CompPict:Colour.a

```
*-----------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*-----------------------------------
*
*   68030 Colour space conversions
*
*-----------------------------------
        machine mc68030
        seg     'klics'
        include 'Traps.a'
*-----------------------------------
        macro
        DPY32x2     &ARGB, &row, &o0, &o1, &n0, &n1
*
        add.l       &n0,&o0                 ;
        lsr.l       #1,&o0                  ; interpolate first pixel
        add.l       &n1,&o1                 ;
        lsr.l       #1,&o1                  ; interpolate first pixel

        move.l      &o0,(&ARGB)
        add.l       &row,&ARGB
        move.l      &o0,(&ARGB)
        add.l       &row,&ARGB
        move.l      &o1,(&ARGB)
        add.l       &row,&ARGB
        move.l      &o1,(&ARGB)+

        move.l      &n1,(&ARGB)
        sub.l       &row,&ARGB
        move.l      &n1,(&ARGB)
        sub.l       &row,&ARGB
        move.l      &n0,(&ARGB)
        sub.l       &row,&ARGB
        move.l      &n0,(&ARGB)+
*
        endm
*-----------------------------------
        macro
        DPY32       &ARGB, &row, &o0, &o1, &n0, &n1
*
        move.l      &o0,(&ARGB)
        add.l       &row,&ARGB
        move.l      &o1,(&ARGB)+

        move.l      &n1,(&ARGB)
        sub.l       &row,&ARGB
        move.l      &n0,(&ARGB)+
*
        endm
*-----------------------------------
        macro
        UV2RGB32    &AU,&AV,&TAB
*
        add.l       #2048,&TAB              ; move to uvtab

        move.w      &AU,d1                  ; Load U
        lsr.w       #2,d1
        and.w       #$01FF,d1
```

Engineering:KlicsCode:CompPict:Colour.a

```
        move.l      (&TAB,d1.w*8),d0        ; UV now rg (u)

        move.w      &AV,d1                  ; Load V
        lsr.w       #2,d1
        and.w       #$01FF,d1
        add.l       4(&TAB,d1.w*8),d0       ; UV now rgb

        move.l      d0,d1                   ; 3 copies
        move.l      d0,d2
        move.l      d0,d3

        sub.l       #2048,&TAB              ; restore ytab

        endm
*-----------------------------------
        macro
        GETY32      &AY, &TAB, &RGB0, &RGB1

        move.l      &AY,d4                  ;Y
        lsr.w       #2,d4
        and.w       #$01FF,d4
        add.l       (&TAB,d4.w*4),&RGB1     ; RGB1+=YYY

        swap        d4
        lsr.w       #2,d4
        and.w       #$01FF,d4
        add.l       (&TAB,d4.w*4),&RGB0     ; RGB0+=YYY

        endm
*-----------------------------------
        macro
        OVER32      &RGB

        move.l      &RGB,d4         ; copy pixel
        andi.l      #$01010100,d4   ; was it this rgb
        beq.s       @nx_rgb         ; if not then quit
        btst        #24,d4          ; R overflow?
        beq.s       @bit16          ; if not then continue
        btst        #23,&RGB        ; test sign
        beq.s       @pos23          ; if positive
        andi.l      #$0000ffff,&RGB ; underflow sets R to 0
        bra.s       @bit16          ; do next bit
@pos23  ori.l       #$00ff0000,&RGB ; overflow sets R to 255
@bit16  btst        #16,d4          ; G overflow?
        beq.s       @bit8           ; if not then continue
        btst        #15,&RGB        ; test sign
        beq.s       @pos16          ; if positive
        andi.w      #$00ff,&RGB     ; underflow sets G to 0
        bra.s       @bit8           ; do next bit
@pos16  ori.w       #$ff00,&RGB     ; overflow sets G to 255
@bit8   btst        #8,d4           ; B overflow?
        beq.s       @end            ; if not then continue
        btst        #7,&RGB         ; test sign
        seq         &RGB            ; under/over flow
@end    andi.l      #$00fefefe,&RGB ; mask RGB ok
@nx_rgb

        endm
*-----------------------------------
        macro
        HASHOUT32   &AH, &D0, &D1, &D2, &D3

        move.l      &D0,d4
```

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```
        add.l   &D1,d4
        add.l   &D2,d4
        add.l   &D3,d4
        andi.l  #$03e3e3e0,d4
        move.l  d4,&AH
*
        endm
*---------------------------------
        macro
        HASHCMP32   &AH, &D0, &D1, &D2, &D3
*
        move.l  &D0,d4
        add.l   &D1,d4
        add.l   &D2,d4
        add.l   &D3,d4
        andi.l  #$03e3e3e0,d4
        cmp.l   &AH,d4
*
        endm
*---------------------------------
OUT32X2 FUNC    EXPORT
*
PS      RECORD  8
table   DS.L    1
pixmap  DS.L    1
Y       DS.L    1
U       DS.L    1
V       DS.L    1
width   DS.L    1
height  DS.L    1
rowByte DS.L    1
pixmap2 DS.L    1
        ENDR
*
LS      RECORD  0,DECR
Y1      DS.L    1           ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L    1           ; x end address                 = U+U_ix
U_ey    DS.L    1           ; y end address                 = U+width*height>>
U_ix    DS.L    1           ; sizeof(short)*UVrow           = width
Y_y     DS.L    1           ; sizeof(short)*Yrow            = 2*width
P_y     DS.L    1           ; 4*rowBytes-sizeof(long)*Prow  = 4*rowBytes-width
LSize   EQU     *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - old0, d7
*
        link    a6,#LS.LSize        ; inc, width, fend and rowend are loca
        movem.l d4-d7/a3-a5,-(a7)   ; store registers
*
        move    SR,d0

        move.l  PS.Y(a6),a0         ; Y=Yc
        move.l  PS.U(a6),a1         ; U=Uc
        move.l  PS.V(a6),a2         ; V=Vc
        move.l  PS.pixmap(a6),a3    ; pm=pixmap
        move.l  PS.table(a6),a4     ; tab=table
        move.l  PS.pixmap2(a6),a5   ; pm2=pixmap2

        move.l  PS.width(a6),d0     ; LOAD width
        move.l  d0,LS.U_ix(a6)      ; SAVE U_ix
        move.l  PS.height(a6),d1    ; LOAD height
        mulu.w  d0,d1               ;  width*height
```

Engineering:KlicsCode:CompPict:Colour.a

```
        lsr.l       #1,d1                   ;  width*height/2
        add.l       a1,d1                   ;  U+width*height/2
        move.l      d1,LS.U_ey(a6)          ; SAVE U_ey
        add.l       d0,d0                   ;  width*2
        move.l      d0,LS.Y1(a6)            ; SAVE Y1
        move.l      d0,LS.Y_y(a6)           ; SAVE Y_y
        lsl.l       #2,d0                   ;  width*8
        move.l      PS.rowByte(a6),d1       ; LOAD rowBytes
        lsl.l       #2,d1                   ;  rowBytes*4
        sub.l       d0,d1                   ;  rowBytes*4-width*8
        move.l      d1,LS.P_y(a6)           ; SAVE P_y

        move.l      PS.rowByte(a6),d5       ; load rowBytes
        clr.l       d6                      ; clear old2
        clr.l       d7                      ; clear old1

@do_y   move.l      LS.U_ix(a6),d0          ; LOAD U_ixB
        add.l       a1,d0                   ;  P+U_ixB
        move.l      d0,LS.U_ex(a6)          ; SAVE U_exB

@do_x   UV2RGB32    (a1)+,(a2)+,a4          ; uv2rgb(*U++,*V++)

        move.l      LS.Y1(a6),d4            ; load Yrow
        GETY32      (a0,d4.l),a4,d2,d3      ; add Yb to RGB values
        GETY32      (a0)+,a4,d0,d1          ; add Ya to RGB values

        move.l      d0,d4
        or.l        d1,d4
        or.l        d2,d4
        or.l        d3,d4
        andi.l      #$01010100,d4
        bne.s       @over                   ; if overflow

@ok     HASHOUT32   (a5)+,d0,d1,d2,d3

        DPY32x2     a3,d5,d6,d7,d0,d2
        DPY32x2     a3,d5,d0,d2,d1,d3

        move.l      d1,d6                   ; copy olds
        move.l      d3,d7

        cmpa.l      LS.U_ex(a6),a1
        blt.w       @do_x

        add.l       LS.Y_y(a6),a0
        add.l       LS.P_y(a6),a3

        cmpa.l      LS.U_ey(a6),a1
        blt.w       @do_y

        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
@over   OVER32      d0
        OVER32      d1
        OVER32      d2
        OVER32      d3
        bra         @ok
*
        ENDFUNC
*-------------------------------
OUT32X2D    FUNC    EXPORT
*
```

Engineering:KlicsCode:CompPict:Colour.a

```
PS      RECORD  ➡ 8
table   DS.L      1
pixmap  DS.L      1
Y       DS.L      1
U       DS.L      1
V       DS.L      1
width   DS.L      1
height  DS.L      1
rowByte DS.L      1
pixmap2 DS.L      1
        ENDR
*
LS      RECORD    0,DECR
Y1      DS.L      1           ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L      1           ; x end address                 = U+U_ix
U_ey    DS.L      1           ; y end address                 = U+width*height>>
U_ix    DS.L      1           ; sizeof(short)*UVrow           = width
Y_y     DS.L      1           ; sizeof(short)*Yrow            = 2*width
P_y     DS.L      1           ; 4*rowBytes-sizeof(long)*Prow  = 4*rowBytes-width
LSize   EQU       *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - old0, d7
*
        link      a6,#LS.LSize          ; inc, width, fend and rowend are loca
        movem.l   d4-d7/a3-a5,-(a7)     ; store registers
*
        move.l    PS,Y(a6),a0           ; Y=Yc
        move.l    PS.U(a6),a1           ; U=Uc
        move.l    PS.V(a6),a2           ; V=Vc
        move.l    PS.pixmap(a6),a3      ; pm=pixmap
        move.l    PS.table(a6),a4       ; tab=table
        move.l    PS.pixmap2(a6),a5     ; pm2=pixmap2

        move.l    PS.width(a6),d0       ; LOAD width
        move.l    d0,LS.U_ix(a6)        ; SAVE U_ix
        move.l    PS.height(a6),d1      ; LOAD height
        mulu.w    d0,d1                 ;  width*height
        lsr.l     #1,d1                 ;  width*height/2-
        add.l     a1,d1                 ;  U+width*height/2
        move.l    d1,LS.U_ey(a6)        ; SAVE U_ey
        add.l     d0,d0                 ;  width*2
        move.l    d0,LS.Y1(a6)          ; SAVE Y1
        move.l    d0,LS.Y_y(a6)         ; SAVE Y_y
        lsl.l     #2,d0                 ;  width*8
        move.l    PS.rowByte(a6),d1     ; LOAD rowBytes
        lsl.l     #2,d1                 ;  rowBytes*4
        sub.l     d0,d1                 ;  rowBytes*4-width*8
        move.l    d1,LS.P_y(a6)         ; SAVE P_y

        move.l    PS.rowByte(a6),d5     ; load rowBytes
        clr.l     d6                    ; clear old2
        clr.l     d7                    ; clear old1

@do_y   move.l    LS.U_ix(a6),d0        ; LOAD U_ixB
        add.l     a1,d0                 ;  P+U_ixB
        move.l    d0,LS.U_ex(a6)        ; SAVE U_exB

@do_x   UV2RGB32  (a1)+,(a2)+,a4        ; uv2rgb(*U++,*V++)

        move.l    LS.Y1(a6),d4          ; load Yrow
        GETY32    (a0,d4.l),a4,d2,d3    ; add Yb to RGB values
```

Engineering:KlicsCode:CompPict:Colour.a

```
        GETY32      (a0)+,a4,d0,d1          ; add YA to RGB values

        move.l      d0,d4
        or.l        d1,d4
        or.l        d2,d4
        or.l        d3,d4
        andi.l      #$01010100,d4
        bne.w       @over                   ; if overflow

@ok     HASHCMP32   (a5)+,d0,d1,d2,d3
        bne.s       @diff

        add.l       #16,a3                  ; add four pixels

@cont   move.l      d1,d6                   ; copy olds
        move.l      d3,d7

        cmpa.l      LS.U_ex(a6),a1
        blt.w       @do_x

        add.l       LS.Y_y(a6),a0
        add.l       LS.P_y(a6),a3

        cmpa.l      LS.U_ey(a6),a1
        blt.w       @do_y
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
@diff   move.l      d4,-4(a5)
        DPY32x2     a3,d5,d6,d7,d0,d2
        DPY32x2     a3,d5,d0,d2,d1,d3
        bra.s       @cont
@over   OVER32      d0
        OVER32      d1
        OVER32      d2
        OVER32      d3
        bra         @ok
*
        ENDFUNC
*-----------------------------------
OUT32   FUNC    EXPORT
*
PS      RECORD      8
table   DS.L        1
pixmap  DS.L        1
Y       DS.L        1
U       DS.L        1
V       DS.L        1
width   DS.L        1
height  DS.L        1
rowByte DS.L        1
pixmap2 DS.L        1
        ENDR
*
LS      RECORD      0,DECR
Y1      DS.L        1           ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L        1           ; x end address                 = U+U_ix
U_ey    DS.L        1           ; y end address                 = U+width*height>>
U_ix    DS.L        1           ; sizeof(short)*UVrow           = width
Y_y     DS.L        1           ; sizeof(short)*Yrow            = 2*width
P_y     DS.L        1           ; 2*rowBytes-sizeof(long)*Prow  = 2*rowBytes-width
LSize   EQU         *
```

Engineering:KlicsCode:CompPict:Colour.a

```
        ENDR    =>
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - c1d0, d7
*
        link        a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.Y(a6),a0             ; Y=Yc
        move.l      PS.U(a6),a1             ; U=Uc
        move.l      PS.V(a6),a2             ; V=Vc
        move.l      PS.pixmap(a6),a3        ; pm=pixmap
        move.l      PS.table(a6),a4         ; tab=table
        move.l      PS.pixmap2(a6),a5       ; pm2=pixmap2

        move.l      PS.width(a6),d0         ; LOAD width
        move.l      d0,LS.U_ix(a6)          ; SAVE U_ix
        move.l      PS.height(a6),d1        ; LOAD height
        mulu.w      d0,d1                   ;  width*height
        lsr.l       #1,d1                   ;  width*height/2
        add.l       a1,d1                   ;  U+width*height/2
        move.l      d1,LS.U_ey(a6)          ; SAVE U_ey
        add.l       d0,d0                   ;  width*2
        move.l      d0,LS.Y1(a6)            ; SAVE Y1
        move.l      d0,LS.Y_y(a6)           ; SAVE Y_y
        add.l       d0,d0                   ;  width*4
        move.l      PS.rowByte(a6),d1       ; LOAD rowBytes
        add.l       d1,d1                   ;  rowBytes*2
        sub.l       d0,d1                   ;  rowBytes*2-width*4
        move.l      d1,LS.P_y(a6)           ; SAVE P_y

        move.l      PS.rowByte(a6),d5       ; load rowBytes
        move.l      LS.Y1(a6),d6            ; load Yrow

@do_y   move.l      LS.U_ix(a6),d7          ; LOAD U_ixB
        add.l       a1,d7                   ;  P+U_ixB

@do_x   UV2RGB32    (a1)+,(a2)+,a4          ; uv2rgb(*U++,*V++)

        GETY32      (a0,d6.l),a4,d2,d3      ; add Yb to RGB values
        GETY32      (a0)+,a4,d0,d1          ; add Ya to RGB values

        move.l      d0,d4
        or.l        d1,d4
        or.l        d2,d4
        or.l        d3,d4
        andi.l      #$01010100,d4
        bne.s       @over                   ; if overflow

@ok     HASHOUT32   (a5)+,d0,d1,d2,d3

        DPY32       a3,d5,d0,d2,d1,d3

        cmpa.l      d7,a1
        blt.w       @do_x

        add.l       LS.Y_y(a6),a0
        add.l       LS.P_y(a6),a3

        cmpa.l      LS.U_ey(a6),a1
        blt.w       @do_y
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
```

Engineering:KlicsCode:CompPict:Colour.a

```
        unlk    a6                      ; remove locals
        rts                             ; return
@over   OVER32  d0
        OVER32  d1
        OVER32  d2
        OVER32  d3
        bra     @ok
*
        ENDFUNC
*---------------------------------
OUT32D  FUNC    EXPORT
*
PS      RECORD  8
table   DS.L    1
pixmap  DS.L    1
Y       DS.L    1
U       DS.L    1
V       DS.L    1
width   DS.L    1
height  DS.L    1
rowByte DS.L    1
pixmap2 DS.L    1
        ENDR
*
LS      RECORD  0,DECR
Y1      DS.L    1       ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L    1       ; x end address                 = U+U_ix
U_ey    DS.L    1       ; y end address                 = U+width*height>>
U_ix    DS.L    1       ; sizeof(short)*UVrow           = width
Y_y     DS.L    1       ; sizeof(short)*Yrow            = 2*width
P_y     DS.L    1       ; 2*rowBytes-sizeof(long)*Prow  = 2*rowBytes-width
LSize   EQU     *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - Yrow, d7
*
        link    a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l  PS.Y(a6),a0             ; Y=Yc
        move.l  PS.U(a6),a1             ; U=Uc
        move.l  PS.V(a6),a2             ; V=Vc
        move.l  PS.pixmap(a6),a3        ; pm=pixmap
        move.l  PS.table(a6),a4         ; tab=table
        move.l  PS.pixmap2(a6),a5       ; pm2=pixmap2

        move.l  PS.width(a6),d0         ; LOAD width
        move.l  d0,LS.U_ix(a6)          ; SAVE U_ix
        move.l  PS.height(a6),d1        ; LOAD height
        mulu.w  d0,d1                   ;  width*height
        lsr.l   #1,d1                   ;  width*height/2
        add.l   a1,d1                   ;  U+width*height/2
        move.l  d1,LS.U_ey(a6)          ; SAVE U_ey
        add.l   d0,d0                   ;  width*2
        move.l  d0,LS.Y1(a6)            ; SAVE Y1
        move.l  d0,LS.Y_y(a6)           ; SAVE Y_y
        add.l   d0,d0                   ;  width*4
        move.l  PS.rowByte(a6),d1       ; LOAD rowBytes
        add.l   d1,d1                   ;  rowBytes*2
        sub.l   d0,d1                   ;  rowBytes*2-width*4
        move.l  d1,LS.P_y(a6)           ; SAVE P_y
```

Engineering:KlicsCode:CompPict:Colour.a

```
        move.l    => PS.rowByte(a6),d5      ; load rowBytes
        move.l      LS.Y1(a6),d6            ; load Yrow

@do_y   move.l      LS.U_ix(a6),d7          ; LOAD U_ixB
        add.l       a1,d7                   ;  P+U_ixB

@do_x   UV2RGB32    (a1)+,(a2)+,a4          ; uv2rgb(*U++,*V++)

        move.l      LS.Y1(a6),d4            ; load Yrow
        GETY32      (a0,d6.l),a4,d2,d3      ; add Yb to RGB values
        GETY32      (a0)+,a4,d0,d1          ; add Ya to RGB values

        move.l      d0,d4
        or.l        d1,d4
        or.l        d2,d4
        or.l        d3,d4
        andi.l      #$01010100,d4
        bne.s       @over                   ; if overflow

@ok     HASHCMP32   (a5)+,d0,d1,d2,d3
        bne.s       @diff

        addq        #8,a3                   ; add four pixels

@cont   cmpa.l      d7,a1
        blt.w       @do_x

        add.l       LS.Y_y(a6),a0
        add.l       LS.P_y(a6),a3

        cmpa.l      LS.U_ey(a6),a1
        blt.w       @do_y
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
@diff   move.l      d4,-4(a5)
        DPY32       a3,d5,d0,d2,d1,d3
        bra.s       @cont
@over   OVER32      d0
        OVER32      d1
        OVER32      d2
        OVER32      d3
        bra         @ok
*
        ENDFUNC
*---------------------------------
        macro
        UVOV        &VAL, &OV
*
        move.w      &VAL,&OV
        add.w       #$0200,&OV
        and.w       #$FC00,&OV
        beq.s       @ok
        tst.w       &OV
        bge.s       @pos
        move.w      #$01FF,&VAL
        bra.s       @ok
@pos    move.w      #$FE00,&VAL
@ok
*
        endm
```

Engineering:KlicsCode:CompPict:Colour.a

```
UVLIMIT FUNC        EXPORT
* fix d0, d4, spare d1-d2
        UVOV        d0,d1
        swap        d0
        UVOV        d0,d1
        swap        d0
        UVOV        d4,d1
        swap        d4
        UVOV        d4,d1
        swap        d4
        rts
*
        ENDFUNC

        macro
        UVOVER      &U, &V
*
        move.l      #$02000200,d1
        move.l      d1,d2
        add.l       &U,d1
        add.l       &V,d2
        or.l        d2,d1
        andi.l      #$FC00FC00,d1
        beq.s       @UVok
        bsr         UVLIMIT
@UVok
*
        endm

        macro
        GETUV       &AU, &AV, &SP, &UV
*
        move.l      (&AU)+,&SP
        move.l      (&AV)+,&UV
        UVOVER      &SP,&UV
        lsr.l       #5,&UV
        andi.l      #$03e003e0,&SP
        andi.l      #$001F001F,&UV
        or.l        &SP,&UV                 ; UV==$00UV00UV
        swap        &UV
*
        endm

        macro
        GETY        &AY,&IND,&UV,&R0,&R1
*
        move.l      &AY,&R1                 ; (2+) Y=Y0Y1
        lsl.l       #5,&R1                  ; (4) Y=Y0XXY1XX
        andi.l      #$FC00FC00,&R1          ;
        or.w        &UV,&R1                 ; (2) Y=Y1UV
        move.l      (&IND,&R1 .w*4),&R0     ; (2+) R0=0123 (Y1)
        swap        &R1                     ; (4) Y=Y0XX
        or.w        &UV,&R1                 ; (2) Y=Y0UV
        move.l      (&IND,&R1 .w*4),&R1     ; (2+) R1=0123 (Y0)
*
        endm

        macro
        UV8         &AU, &AV, &SP, &UV
*
        move.l      (&AU)+,&SP
        move.l      (&AV)+,&UV
        UVOVER      &SP,&UV
```

Engineering:KlicsCode:CompPict:Colour.a

```
        lsr.l   #2,&SP
        lsr.l   #6,&UV
        andi.l  #$00F000F0,&SP
        andi.l  #$000F000F,&UV
        or.l    &SP,&UV                 ; UV==$00UV00UV
        swap    &UV
*
        endm

        macro
        Y2IND   &Y,&IND,&UV,&D0,&D1
*
        move.l  &Y,&D0                  ; d0=Y0Y1
        lsl.l   #3,&D0                  ; d0=Y0XXY1XX
        move.b  &UV,&D0                 ; d0=Y0XXY1UV
        andi.w  #$3FFF,&D0              ; d0=0YUV(1)
        move.l  (&IND,&D0.w*4),&D1      ; find clut entries
        swap    &D0                     ; d0=Y0XX
        move.b  &UV,&D0                 ; d0=Y0UV
        andi.w  #$3FFF,&D0              ; d0=0YUV(0)
        move.l  (&IND,&D0.w*4),&D0      ; find clut entries
*
        endm

OUT8    FUNC    EXPORT
*
PS      RECORD  8
table   DS.L    1
pixmap  DS.L    1
Y       DS.L    1
U       DS.L    1
V       DS.L    1
width   DS.L    1
height  DS.L    1
rowByte DS.L    1
pixmap2 DS.L    1
        ENDR
*
LS      RECORD  0,DECR
Y1      DS.L    1       ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L    1       ; x end address                 = U+U_ix
U_ey    DS.L    1       ; y end address                 = U+width*height>>
U_ix    DS.L    1       ; sizeof(short)*UVrow           = width
Y_y     DS.L    1       ; sizeof(short)*Yrow            = 2*width
P_y     DS.L    1       ; 2*rowBytes-sizeof(long)*Prow  = 2*rowBytes-width
LSize   EQU     *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - old0, d7
*
        link    a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l  PS.Y(a6),a0             ; Y=Yc
        move.l  PS.U(a6),a1             ; U=Uc
        move.l  PS.V(a6),a2             ; V=Vc
        move.l  PS.pixmap(a6),a3        ; pm=pixmap
        move.l  PS.table(a6),a4         ; tab=table
        adda.l  #$00020000,a4           ; tab+=32768 (longs)
        move.l  PS.pixmap2(a6),a5       ; pm2=pixmap2

        move.l  PS.width(a6),d0         ; LOAD width
```

Engineering:KlicsCode:CompPict:Colour.a

```
        move.l      d0,LS.U_ix(a6)          ; SAVE U_ix
        move.l      PS.height(a6),d1        ; LOAD height
        mulu.w      d0,d1                   ;  width*height
        lsr.l       #1,d1                   ;  width*height/2
        add.l       a1,d1                   ;  U+width*height/2
        move.l      d1,LS.U_ey(a6)          ; SAVE U_ey
        move.l      PS.rowByte(a6),d1       ; LOAD rowBytes
        add.l       d1,d1                   ;  rowBytes*2
        sub.l       d0,d1                   ;  rowBytes*2-width
        move.l      d1,LS.P_y(a6)           ; SAVE P_y
        add.l       d0,d0                   ;  width*2
        move.l      d0,LS.Y1(a6)            ; SAVE Y1
        move.l      d0,LS.Y_y(a6)           ; SAVE Y_y

        move.l      PS.rowByte(a6),d5       ; load rowBytes
        move.l      LS.Y1(a6),d6            ; load Yrow

@do_y   move.l      LS.U_ix(a6),d7          ; LOAD U_ixB
        add.l       a1,d7                   ;  P+U_ixB

@do_x   GETUV       a1,a2,d0,d4

        GETY        (a0,d6.w),a4,d4,d2,d3   ; d2=X0XX. d3=XX1X
        GETY        (a0)+,a4,d4,d0,d1       ; d0=XXX0, d1=1XXX

        move.w      d3,d2                   ; d2=X01X
        lsl.l       #8,d2                   ; d2=01XX
        move.w      d0,d1                   ; d1=1XX0
        swap        d1                      ; d1=X01X
        lsl.l       #8,d1                   ; d1=01XX

        swap        d4                      ; next UV

        GETY        (a0,d6.l),a4,d4,d0,d3   ; d0=X2XX, d3=XX3X
        move.w      d3,d0                   ; d0=X23X
        lsr.l       #8,d0                   ; d0=XX23
        move.w      d0,d2                   ; d2=0123--
        GETY        (a0)+,a4,d4,d0,d3       ; d0=XXX2, d3=3XXX
        move.w      d0,d3                   ; d3=3XX2
        swap        d3                      ; d3=X23X
        lsr.l       #8,d3                   ; d3=XX23
        move.w      d3,d1                   ; d1=C123

        move.l      d2,(a3,d5)
        move.l      d1,(a3)+

        cmpa.l      d7,a1
        blt.w       @do_x

        add.l       LS.Y_y(a6),a0
        add.l       LS.P_y(a6),a3

        cmpa.l      LS.U_ey(a6),a1
        blt.w       @do_y
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts         ; return
*
        ENDFUNC
*---------------------------------
        macro
        Y8x2        &AY,&IND,&UV,&old
```

Engineering:KlicsCode:CompPict:Colour.a

```
*
        move.l      &AY,d0                  ; (2+) Y=Y0Y1
        lsl.l       #3,d0                   ; (4) Y=Y0XXY1XX
        swap        d0                      ; (4) Y=Y1XXY0XX
        add.w       d0,&old                 ; (2) old=old+Y0
        lsr.w       #1,&old                 ; (4) old=(old+Y0)/2
        move.b      &UV,&old                ; (2) old=YI0UV
        andi.w      #$3FFF,&old             ; (4) old=0YUV(I0)
        move.l      (&IND,&old .w*4),d1     ; (2+) d1=X1X3
        move.w      d0,&old                 ; (2) old=Y0
        move.b      &UV,d0                  ; (2) Y=Y0UV
        andi.w      #$3FFF,d0               ; (4) Y=0YUV(0)
        move.l      (&IND,d0.w*4),d2        ; (2+) d2=0X2X
        move.w      d1,d3                   ; (2) exg.w d1,d2
        move.w      d2,d1                   ; (2) d1=X12X
        move.w      d3,d2                   ; (2) d2=0XX3
        swap        d2                      ; (4) d2=X30X
        lsl.l       #8,d1                   ; (4) d1=12XX
        lsl.l       #8,d2                   ; (4) d2=30XX
        swap        d0                      ; (4) Y=Y1XX
        add.w       d0,&old                 ; (2) old=old+Y1
        lsr.w       #1,&old                 ; (4) old=(old+Y1)/2
        move.b      &UV,&old                ; (2) old=YI1UV
        andi.w      #$3FFF,&old             ; (4) old=0YUV(I1)
        move.l      (&IND,&old .w*4),d3     ; (2+) d3=X1X3
        move.w      d0,&old                 ; (2) old=Y1
        move.b      &UV,d0                  ; (2) Y=Y0UV
        andi.w      #$3FFF,d0               ; (4) Y=0YUV(0)
        move.l      (&IND,d0.w*4),d0        ; (2+) d0=0X2X
        move.w      d0,d1                   ; (2) exg.w d0,d3
        move.w      d3,d0                   ; (2) d0=0XX3
        move.w      d1,d3                   ; (2) d3=X12X
        swap        d0                      ; (4) d0=X30X
        lsr.l       #8,d0                   ; (4) d0=XX30
        lsr.l       #8,d3                   ; (4) d3=X12X
        move.w      d0,d2                   ; (2) d2=3030 (YiY0YiY1) (1)
        move.w      d3,d1                   ; (2) d1=2121 (YiY0YiY1) (2)
*
        endm
        macro
        Y8x2a       &AY,&IND,&UV
*
        GETY        &AY,&IND,&UV,d1,d2
*       move.l      &AY,d2                  ; (2+) Y=Y0Y1
*       lsl.l       #3,d2                   ; (4) Y=Y0XXY1XX
*       move.b      &UV,d2                  ; (2) Y=Y1UV
*       andi.w      #$3FFF,d2               ; (4) Y=0YUV(Y1)
*       move.l      (&IND,d2.w*4),d1        ; (2+) d1=0123 (Y1)
*       swap        d2                      ; (4) Y=Y0XX
*       move.b      &UV,d2                  ; (2) Y=Y0UV
*       andi.w      #$3FFF,d2               ; (4) Y=0YUV(Y0)
*       move.l      (&IND,d2.w*4),d2        ; (2+) d2=0123 (Y0)
        move.w      d1,d0                   ; (2) exg.w d2,d1
        move.w      d2,d1                   ; (2) d1=0123 (Y1Y0)
        move.w      d0,d2                   ; (2) d2=0123 (Y0Y1)
        swap        d1                      ; (4) d1=2301 (Y0Y1)
*
        endm

        macro
        Y8x2b       &AY,&IND,&UV
*
        GETY        &AY,&IND,&UV,d1,d2
```

Engineering:KlicsCode:CompPict:Colour.a

```
*       move.l      &AY,d2              ; (2+) Y=Y0Y1
*       lsl.l       #3,d2               ; (4) Y=Y0XXY1XX
*       move.b      &UV,d2              ; (2) Y=Y1UV
*       andi.w      #$3FFF,d2           ; (4) Y=0YUV(Y1)
*       move.l      (&IND,d2.w*4),d1    ; (2+) d1=0123 (Y1)
*       swap        d2                  ; (4) Y=Y0XX
*       move.b      &UV,d2              ; (2) Y=Y0UV
*       andi.w      #$3FFF,d2           ; (4) Y=0YUV(Y0)
*       move.l      (&IND,d2.w*4),d2    ; (2+) d2=0123 (Y0)
        ror.l       #8,d2               ; (6) d2=3012 (Y0)
        ror.l       #8,d1               ; (6) d1=3012 (Y1)
        move.w      d1,d0               ; (2) exg.w d2,d1
        move.w      d2,d1               ; (2) d1=3012 (Y1Y0)
        move.w      d0,d2               ; (2) d2=3012 (Y0Y1)
        swap        d1                  ; (4) d1=1230 (Y0Y1)
        ror.w       #8,d1               ; (6) d1=1203 (Y0Y1)
*
        endm


OUT8x2  FUNC    EXPORT
*
PS      RECORD      8
table   DS.L        1
pixmap  DS.L        1
Y       DS.L        1
U       DS.L        1
V       DS.L        1
width   DS.L        1
height  DS.L        1
rowByte DS.L        1
pixmap2 DS.L        1
        ENDR
*
LS      RECORD      0,DECR
Y1      DS.L        1           ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L        1           ; x end address                 = U+U_ix
U_ey    DS.L        1           ; y end address                 = U+width*height>>
U_ix    DS.L        1           ; sizeof(short)*UVrow           = width
Y_y     DS.L        1           ; sizeof(short)*Yrow            = 2*width
P_y     DS.L        1           ; 4*rowBytes-sizeof(long)*Prow  = 4*rowBytes-width
LSize   EQU         *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d5 - old0, d7
*
        link        a6,#LS.LSize        ; inc, width, fend and rowend are loca
        movem.l     d4-d7/a3-a5,-(a7)   ; store registers
*
        move.l      PS.Y(a6),a0         ; Y=Yc
        move.l      PS.U(a6),a1         ; U=Uc
        move.l      PS.V(a6),a2         ; V=Vc
        move.l      PS.pixmap(a6),a3    ; pm=pixmap
        move.l      PS.table(a6),a4     ; tab=table
        adda.l      #$00020000,a4       ; tab+=32768 (longs)
        move.l      PS.pixmap2(a6),a5   ; pm2=pixmap2

        move.l      PS.width(a6),d0     ; LOAD width
        move.l      d0,LS.U_ix(a6)      ; SAVE U_ix
        move.l      PS.height(a6),d1    ; LOAD height
        mulu.w      d0,d1               ;  width*height
        lsr.l       #1,d1               ;  width*height/2
```

Engineering:KlicsCode:CompPict:Colour.a

```
        add.l       a1,d1                   ;  U+width*height/2
        move.l      d1,LS.U_ey(a6)          ; SAVE U_ey
        add.l       d0,d0                   ;  width*2
        move.l      d0,LS.Y1(a6)            ; SAVE Y1
        move.l      d0,LS.Y_y(a6)           ; SAVE Y_y
        move.l      PS.rowByte(a6),d1       ; LOAD rowBytes
        add.l       d1,d1                   ;  rowBytes*2
        add.l       d1,d1                   ;  rowBytes*4
        sub.l       d0,d1                   ;  rowBytes*4-width*2
        move.l      d1,LS.P_y(a6)           ; SAVE P_y

        move.l      PS.rowByte(a6),d5       ; load rowBytes
        clr.l       d6
        clr.l       d7

@do_y   move.l      LS.U_ix(a6),d0          ; LOAD U_ixB
        add.l       a1,d0                   ;  P+U_ixB
        move.l      d0,LS.U_ex(a6)          ; SAVE U_exB

@do_x   GETUV       a1,a2,d0,d4             ; d4=00UV00UV (10)

        Y8x2a       (a0),a4,d4;,d6          ; calc d2,d1 pixels
        move.l      d2,(a3)
        add.l       d5,a3
        move.l      d1,(a3)
        add.l       d5,a3

        move.l      LS.Y1(a6),d0            ; load Yrow
        Y8x2b       (a0,d0.w),a4,d4;,d7     ; calc d2,d1 pixels
        move.l      d2,(a3)
        add.l       d5,a3
        move.l      d1,(a3)+

        swap        d4                      ; next UV
        addq.l      #4,a0                   ; next Y8

        move.l      LS.Y1(a6),d0            ; load Yrow
        Y8x2b       (a0,d0.w),a4,d4;,d7     ; calc d2,d1 pixels
        move.l      d1,(a3)
        sub.l       d5,a3
        move.l      d2,(a3)
        sub.l       d5,a3

        Y8x2a       (a0)+,a4,d4;,d6
        move.l      d1,(a3)
        sub.l       d5,a3
        move.l      d2,(a3)+

        cmpa.l      LS.U_ex(a6),a1
        blt.w       @do_x

        add.l       LS.Y_y(a6),a0
        add.l       LS.P_y(a6),a3

        cmpa.l      LS.U_ey(a6),a1
        blt.w       @do_y

        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts         ; return

        ENDFUNC
;-------------------------------
```

Engineering:KlicsCode:CompPict:Colour.a

```
        macro
        RGB2Y   &RGB,&Y,&U,&V,&AY

        move.l      &RGB,d2                 ; pixel='pixmap
        eori.l      #$808080,d2             ; pixel^=0x808080
        clr.w       d1                      ; B=0
        move.b      d2,d1                   ; B=pixel[3]
        move.l      4(a4,d1.w*8),d0         ; d0=by,bu
        sub.w       d0,&U                   ; U-=bu
        swap        d0                      ; d0=bu,by
        move.w      d0,&Y                   ; Y=by
        ext.w       d1                      ; (short)B
        add.w       d1,d1                   ; B*=2
        add.w       d1,&V                   ; V+=B<<1
        lsr.l       #8,d2                   ; pixel>>=8
        clr.w       d1                      ; G=0
        move.b      d2,d1                   ; G=pixel[3]
        move.l      (a4,d1.w*8),d0          ; d0=gry,gv
        sub.w       d0,&U                   ; U-=gv
        swap        d0                      ; d0=gv,gry
        sub.w       d0,&Y                   ; Y-=gry
        move.l      4(a4,d1.w*8),d0         ; d0=gby,gu
        sub.w       d0,&V                   ; V-=gv
        swap        d0                      ; d0=gu,gby
        sub.w       d0,&Y                   ; Y-=gby
        ext.w       d1                      ; (short)G
        sub.w       d1,&U                   ; U-=g
        sub.w       d1,&V                   ; V-=g
        lsl.w       #2,d1                   ; G<<=2
        add.w       d1,&Y                   ; Y+=B<<1
        lsr.l       #8,d2                   ; pixel>>=8
        move.l      (a4,d2.w*8),d0          ; d0=ry,rv
        sub.w       d0,&V                   ; V-=rv
        swap        d0                      ; d0=rv,ry
        add.w       d0,&Y                   ; Y+=ry
        ext.w       d2                      ; (short)R
        add.w       d2,d2                   ; R*=2
        add.w       d2,&U                   ; U+=R<<2
        cmpi.w      #$FE40,&Y               ; Y>=-448
        bge.s       @ok                     ; if greater
        move.w      #$FE40,&Y               ; Y= -448
        bra.s       @end                    ; save
@ok     cmpi.w      #$01C0,&Y               ; Y< 448
        blt.s       @end                    ; if less
        move.w      #$01C0,&Y               ; Y= 447
@end    move.w      &Y,&AY                  ; Save Y

        endm

IN32    FUNC    EXPORT

PS      RECORD      8
table   DS.L        1
pixmap  DS.L        1
Y       DS.L        1
U       DS.L        1
V       DS.L        1
width   DS.L        1
height  DS.L        1
rowByte DS.L        1
        ENDR

LS      RECORD      0,DECR
```

Engineering:KlicsCode:CompPict:Colour.a

```
Y1      DS.L    = 1         ; sizeof(short)*Yrow          = 2*width
U_ex    DS.L      1         ; x end address               = U+U_ix
U_ey    DS.L      1         ; y end address               = U+width*height>>
U_ix    DS.L      1         ; sizeof(short)*UVrow         = width
Y_y     DS.L      1         ; sizeof(short)*Yrow          = 2*width
P_y     DS.L      1         ; 2*rowBytes-sizeof(long)*Prow = 2*rowBytes-width
LSize   EQU       *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - old0, d7
*
        link        a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.Y(a6),a0             ; Y=Yc
        move.l      PS.U(a6),a1             ; U=Uc
        move.l      PS.V(a6),a2             ; V=Vc
        move.l      PS.pixmap(a6),a3        ; pm=pixmap
        move.l      PS.table(a6),a4         ; tab=table

        move.l      PS.width(a6),d0         ; LOAD width
        move.l      d0,LS.U_ix(a6)          ; SAVE U_ix
        move.l      PS.height(a6),d1        ; LOAD height
        mulu.w      d0,d1                   ;  width*height
        lsr.l       #1,d1                   ;  width*height/2
        add.l       a1,d1                   ;  U+width*height/2
        move.l      d1,LS.U_ey(a6)          ; SAVE U_ey
        add.l       d0,d0                   ;  width*2
        move.l      d0,LS.Y1(a6)            ; SAVE Y1
        move.l      d0,LS.Y_y(a6)           ; SAVE Y_y
        add.l       d0,d0                   ;  width*4
        move.l      PS.rowByte(a6),d1       ; LOAD rowBytes
        add.l       d1,d1                   ;  rowBytes*2
        sub.l       d0,d1                   ;  rowBytes*2-width*4
        move.l      d1,LS.P_y(a6)           ; SAVE P_y

        move.l      PS.rowByte(a6),d7       ; load rowBytes
        move.l      LS.Y1(a6),d6            ; load Y1

@do_y   move.l      LS.U_ix(a6),d0          ; LOAD U_ixB
        add.l       a1,d0                   ;  P+U_ixB
        move.l      d0,LS.U_ex(a6)          ; SAVE U_exB

@do_x   clr.w       d4                      ; U=0
        clr.w       d5                      ; V=0

        RGB2Y       (a3,d7.w),d3,d4,d5,(a0,d6.w); Convert pixel
        RGB2Y       (a3)+,d3,d4,d5,(a0)+        ; Convert pixel
        RGB2Y       (a3,d7.w),d3,d4,d5,(a0,d6.w); Convert pixel
        RGB2Y       (a3)+,d3,d4,d5,(a0)+        ; Convert pixel

        asr.w       #2,d4                   ; U>>=2
        asr.w       #2,d5                   ; V>>=2

        cmpi.w      #$FE40,d4               ; U>=-448
        bge.s       @okU                    ; if greater
        move.w      #$FE40,d4               ; U= -448
        bra.s       @doV                    ; save
@okU    cmpi.w      #$01C0,d4               ; U< 448
        blt.s       @doV                    ; if less
        move.w      #$01C0,d4               ; U= 448
```

Engineering:KlicsCode:CompPict:Colour.a

```
@doV    cmpi.w  #$FE40,d5               ; V>=-448
        bge.s   @okV                    ; if greater
        move.w  #$FE40,d5               ; V= -448
        bra.s   @end                    ; save
@okV    cmpi.w  #$01CC,d5               ; V< 448
        blt.s   @end                    ; if less
        move.w  #$01C0,d5               ; V= 448

@end    move.w  d4,(a1)+                ; Save U
        move.w  d5,(a2)+                ; Save V

        cmpa.l  LS.U_ex(a6),a1
        blt.w   @do_x

        add.l   LS.Y_y(a6),a0
        add.l   LS.P_y(a6),a3

        cmpa.l  LS.U_ey(a6),a1
        blt.w   @do_y
*
        movem.l (a7)+,d4-d7/a3-a5       ; restore registers
        unlk    a6                      ; remove locals
        rts     ; return
*
        ENDFUNC
*-------------------------------
        macro
        UV16    &AU, &AV, &SP, &UV
*
        move.l  (&AU)+,&SP
        move.l  (&AV)+,&UV
        UVOVER  &SP,&UV
        lsr.l   #5,&UV
        andi.l  #$03e003e0,&SP
        andi.l  #$001F001F,&UV
        or.l    &SP,&UV                 ; UV==$00UV00UV
        swap    &UV
*
        endm

        macro
        Y16x2   &AY,&IND,&UV
*
        move.l  &AY,d2                  ; (2+) Y=Y0Y1
        lsl.l   #5,d2                   ; (4) Y=Y0XXY1XX
        andi.l  #$FC00FC00,d2           ;
        or.w    &UV,d2                  ; (2) Y=Y1UV
        move.l  (&IND,d2.w*4),d1        ; (2+) d1=0123 (Y1)
        swap    d2                      ; (4) Y=Y0XX
        or.w    &UV,d2                  ; (2) Y=Y0UV
        move.l  (&IND,d2.w*4),d2        ; (2+) d2=0123 (Y0)
*
        endm


OUT16x2 FUNC    EXPORT
*
PS      RECORD  0
table   DS.L    1
pixmap  DS.L    1
Y       DS.L    1
U       DS.L    1
V       DS.L    1
```

Engineering:KlicsCode:CompPict:Colour.a

```
width   DS.L    1
height  DS.L    1
rowByte DS.L    1
pixmap2 DS.L    1
        ENDR
*
LS      RECORD  0,DECR
Y1      DS.L    1       ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L    1       ; x end address                 = U+U_ix
U_ey    DS.L    1       ; y end address                 = U+width*height>>
U_ix    DS.L    1       ; sizeof(short)*UVrow           = width
Y_y     DS.L    1       ; sizeof(short)*Yrow            = 2*width
P_y     DS.L    1       ; 4*rowBytes-sizeof(long)*Prow  = 4*rowBytes-width
LSize   EQU     *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - old0, d7
*
        link    a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l  PS.Y(a6),a0             ; Y=Yc
        move.l  PS.U(a6),a1             ; U=Uc
        move.l  PS.V(a6),a2             ; V=Vc
        move.l  PS.pixmap(a6),a3        ; pm=pixmap
        move.l  PS.table(a6),a4         ; tab=table
        adda.l  #$00020000,a4           ; tab+=32768 (longs)
        move.l  PS.pixmap2(a6),a5       ; pm2=pixmap2

        move.l  PS.width(a6),d0         ; LOAD width
        move.l  d0,LS.U_ix(a6)          ; SAVE U_ix
        move.l  PS.height(a6),d1        ; LOAD height
        mulu.w  d0,d1                   ;  width*height
        lsr.l   #1,d1                   ;  width*height/2
        add.l   a1,d1                   ;  U+width*height/2
        move.l  d1,LS.U_ey(a6)          ; SAVE U_ey
        add.l   d0,d0                   ;  width*2
        move.l  d0,LS.Y1(a6)            ; SAVE Y1
        move.l  d0,LS.Y_y(a6)           ; SAVE Y_y
        add.l   d0,d0                   ;  width*4
        move.l  PS.rowByte(a6),d1       ; LOAD rowBytes
        add.l   d1,d1                   ;  rowBytes*2
        add.l   d1,d1                   ;  rowBytes*4
        sub.l   d0,d1                   ;  rowBytes*4-width*4
        move.l  d1,LS.P_y(a6)           ; SAVE P_y

        move.l  PS.rowByte(a6),d5       ; load rowBytes
        clr.l   d6
        clr.l   d7

@do_y   move.l  LS.U_ix(a6),d0          ; LOAD U_ixB
        add.l   a1,d0                   ;  P+U_ixB
        move.l  d0,LS.U_ex(a6)          ; SAVE U_exB

@do_x   GETUV   a1,a2,d0,d4             ; d4=00UV00UV (10)

        GETY    (a0),a4,d4,d1,d2        ; calc d2,d1 pixel
        move.l  d2,(a3)+
        move.l  d1,(a3)
        add.l   d5,a3
        swap    d1
        move.l  d1,(a3)
```

Engineering:KlicsCode:CompPict:Colour.a

```
        swap    d2
        move.l  d2,-(a3)
        add.l   d5,a3

        move.l  LS.Y1(a6),d0            ; load Yrow
        GETY    (a0,d0.w),a4,d4,d1,d2   ; calc d2,d1 pixels
        move.l  d2,(a3)+
        move.l  d1,(a3)
        add.l   d5,a3
        swap    d1
        move.l  d1,(a3)
        swap    d2
        move.l  d2,-(a3)

        swap    d4                      ; next UV
        addq.l  #4,a0                   ; next Ys
        add.l   #12,a3

        move.l  LS.Y1(a6),d0            ; load Yrow
        GETY    (a0,d0.w),a4,d4,d1,d2   ; calc d2,d1 pixels
        move.l  d1,(a3)
        move.l  d2,-(a3)
        sub.l   d5,a3
        swap    d2
        move.l  d2,(a3)+
        swap    d1
        move.l  d1,(a3)
        sub.l   d5,a3

        GETY    (a0)+,a4,d4,d1,d2
        move.l  d1,(a3)
        move.l  d2,-(a3)
        swap    d2
        sub.l   d5,a3
        move.l  d2,(a3)+
        swap    d1
        move.l  d1,(a3)+

        cmpa.l  LS.U_ex(a6),a1
        blt.w   @do_x

        add.l   LS.Y_y(a6),a0
        add.l   LS.P_y(a6),a3

        cmpa.l  LS.U_ey(a6),a1
        blt.w   @do_y

        movem.l (a7)+,d4-d7/a3-a5       ; restore registers
        unlk    a6                      ; remove locals
        rts     ; return

        ENDFUNC
;-----------------------------------
        macro
        Y16     &AY,&IND,&UV

        move.l  &AY,d2                  ; (2+) Y=Y0Y1
        lsl.l   #5,d2                   ; (4) Y=Y0XXY1XX
        andi.l  #$FC00FC00,d2           ;
        or.w    &UV,d2                  ; (2) Y=Y1UV
        move.l  (&IND,d2.w*4),d1        ; (2+) d1=Y1
        swap    d2                      ; (4) Y=Y0XX
        or.w    &UV,d2                  ; (2) Y=Y0UV
```

```
                    Engineering:KlicsCode:CompPict:Colour.a
                    ➢
        move.l      (&IND,d2.w*4),d2        ; (2-) d2=Y0
        move.w      d1,d2                   ; (2) d2=Y0Y1
*
        endm

CUT16   FUNC    EXPORT
*
PS      RECORD      8
table   DS.L        1
pixmap  DS.L        1
Y       DS.L        1
U       DS.L        1
V       DS.L        1
width   DS.L        1
height  DS.L        1
rowByte DS.L        1
pixmap2 DS.L        1
        ENDR
*
LS      RECORD      0,DECR
Y1      DS.L        1           ; sizeof(short)*Yrow            = 2*width
U_ex    DS.L        1           ; x end address                 = U+U_ix
U_ey    DS.L        1           ; y end address                 = U+width*height>>
U_ix    DS.L        1           ; sizeof(short)*UVrow           = width
Y_y     DS.L        1           ; sizeof(short)*Yrow            = 2*width
P_y     DS.L        1           ; 2*rowBytes-sizeof(long)*Prow  = 2*rowBytes-width
LSize   EQU         *
        ENDR
*
*       a0 - Y, a1 - U, a2 - V, a3 - pixmap, a4 - table, a5 - pixmap2
*       d0 - rgb00, d1 - rgb01, d2 - rgb10, d3 - rgb11, d4 - spare, d6 - old0, d7
*
        link        a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.Y(a6),a0             ; Y=Yc
        move.l      PS.U(a6),a1             ; U=Uc
        move.l      PS.V(a6),a2             ; V=Vc
        move.l      PS.pixmap(a6),a3        ; pm=pixmap
        move.l      PS.table(a6),a4         ; tab=table
        adda.l      #$00020000,a4           ; tab+=32768 (longs)
        move.l      PS.pixmap2(a6),a5       ; pm2=pixmap2

        move.l      PS.width(a6),d0         ; LOAD width
        move.l      d0,LS.U_ix(a6)          ; SAVE U_ix
        move.l      PS.height(a6),d1        ; LOAD height
        mulu.w      d0,d1                   ;  width*height
        lsr.l       #1,d1                   ;  width*height/2
        add.l       a1,d1                   ;  U+width*height/2
        move.l      d1,LS.U_ey(a6)          ; SAVE U_ey
        add.l       d0,d0                   ;  width*2
        move.l      d0,LS.Y1(a6)            ; SAVE Y1
        move.l      d0,LS.Y_y(a6)           ; SAVE Y_y
        move.l      PS.rowByte(a6),d1       ; LOAD rowBytes
        add.l       d1,d1                   ;  rowBytes*2
        sub.l       d0,d1                   ;  rowBytes*2-width*2
        move.l      d1,LS.P_y(a6)           ; SAVE P_y

        move.l      PS.rowByte(a6),d5       ; load rowBytes
        clr.l       d6
        clr.l       d7

@do_y   move.l      LS.U_ix(a6),d0          ; LOAD U_ixB
```

```
        add.l       a3,d0                   ;  P+U_ixB
        move.l      d0,LS.U_ex(a6)          ; SAVE U_exB

@do_x   GETUV       a1,a2,d0,d4             ; d4=00UV00UV (10)

        GETY        (a0),a4,d4,d1,d2        ; calc d2,d1 pixel
        move.w      d1,d2
        move.l      d2,(a3)
        add.l       d5,a3

        move.l      LS.Y1(a6),d0            ; load Yrow
        GETY        (a0,d0.w),a4,d4,d1,d2   ; calc d2,d1 pixels
        move.w      d1,d2
        move.l      d2,(a3)+

        swap        d4                      ; next UV
        addq.l      #4,a0                   ; next Ys

        move.l      LS.Y1(a6),d0            ; load Yrow
        GETY        (a0,d0.w),a4,d4,d1,d2   ; calc d2,d1 pixels
        move.w      d1,d2
        move.l      d2,(a3)
        sub.l       d5,a3

        GETY        (a0)+,a4,d4,d1,d2
        move.w      d1,d2
        move.l      d2,(a3)+

        cmpa.l      LS.U_ex(a6),a1
        blt.w       @do_x

        add.l       LS.Y_y(a6),a0
        add.l       LS.P_y(a6),a3

        cmpa.l      LS.U_ey(a6),a1
        blt.w       @do_y

        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return

        ENDFUNC
;-----------------------------------
        END
```

Engineering:KlicsCode:CompPict:Color2.a

```
*---------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*---------------------------------
*
*   68000 Fast RGB/YUV code
*
*---------------------------------
        include 'Traps.a'
        machine mc68030
*---------------------------------
        macro
        RGB2Y   &Apixel,&AY
*
*       d0 - pixel/r, d1 - g/2g+r, d2 - b, d3 - Y
*
        move.l  &Apixel,d0      ; pixel=*Apixel
        eor.l   #$00808080,d0   ; signed pixels

        move.b  d0,d2           ; b=pixel[3]
        ext.w   d2              ; b is 8(16) bit

        move.w  d0,d1           ; g=pixel[2]
        asr.w   #7,d1           ; 2g is 9(16) bit

        swap    d0              ; r=pixel[1]
        ext.w   d0              ; r is 8(16) bit

        move.w  d2,d3           ; Y=b
        lsl.w   #3,d3           ; Y<<=3
        sub.w   d2,d3           ; Y-=b

        add.w   d0,d1           ; 2g+=r
        add.w   d1,d3           ; Y+=2g+r
        add.w   d1,d3           ; Y+=2g+r
        add.w   d1,d3           ; Y+=2g+r
        asr.w   #4,d3           ; Y>>=4
        add.w   d1,d3           ; Y+=2g+r
        move.w  d3,&AY          ; AY=Y is 10(16) bit
*
        endm
*---------------------------------
        macro
        RGB2UV  &AU,&AV
*
*       d0 - r, d2 - b, d3 - Y, d1 - U/V
*
        add.w   d0,d0           ; r is 9(16) bit
        add.w   d2,d2           ; b is 9(16) bit
        asr.w   #1,d3           ; Y is 9(16) bit
        move.w  d2,d1           ; U=b
        sub.w   d3,d1           ; U=b-Y
        move.w  d1,&AU          ; AU=U
        move.w  d0,d1           ; V=r
        sub.w   d3,d1           ; V=r-Y
        move.w  d1,&AV          ; AV=V
*
        endm
*---------------------------------
```

Engineering:KlicsCode:CompPict:Color2.a

```
        if  &TYPE('seg')#'UNDEFINED' then
        seg         &seg
        endif

RGB2YUV2    FUNC    EXPORT
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7/a3,-(a7)          ; store registers
*
        move.l      $0008(a6),a3            ; pm=pixmap
        move.l      $000C(a6),a0            ; Y=Yc
        move.l      $0010(a6),a1            ; U=Uc
        move.l      $0014(a6),a2            ; V=Vc
        move.l      $0018(a6),d7            ; fend=area
        asl.l       #2,d7                   ; fend<<=2
        add.l       a3,d7                   ; fend+=pm
        move.l      $001C(a6),d4            ; width_b=width
        asl.l       #2,d4                   ; width_b<<=2
        move.l      $0020(a6),d5            ; inc_b=cols
        asl.l       #2,d5                   ; cols<<=2
        sub.l       d4,d5                   ; inc_b-=width_b
@do1    move.l      a3,d6                   ; rowend=pm
        add.l       d4,d6                   ; rowend+=width_b
@do2    rgb2y       (a3)+,(a0)+             ; rgb2y(pm++,Y++)
        rgb2uv      (a1)+,(a2)+             ; rgb2uv(U++,V++)
        rgb2y       (a3)+,(a0)+             ; rgb2y(pm++,Y++)
        cmpa.l      d6,a3                   ; rowend>pm
        blt.s       @do2                    ; while
        adda.l      d5,a3                   ; pm+=inc_b
        move.l      a3,d6                   ; rowend=pm
        add.l       d4,d6                   ; rowend+=width_b
@do3    rgb2y       (a3)+,(a0)+             ; rgb2y(pm++,Y++)
        cmpa.l      d6,a3                   ; rowend>pm
        blt.s       @do3                    ; while
        adda.l      d5,a3                   ; pm+=inc_b
        cmpa.l      d7,a3                   ; fend>pm
        blt.w       @do1                    ; while -
*
        movem.l     (a7)+,d4-d7/a3          ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-----------------------------------
        macro
        FETCHY      &AY, &Y, &R, &G, &B
*
        move.l      &AY,&Y                  ; Y=*AY++
        add.l       &Y,&R                   ; RR+=Y12
        add.l       &Y,&G                   ; GG+=Y12
        add.l       &Y,&B                   ; BB+=Y12
*
        endm
*-----------------------------------
        macro
        FIXOV       &V, &SP1, &SP2
*
        move.w      &V,&SP1
        clr.b       &SP1
        andi.w      #$3FFF,&SP1
        sne         &SP1
        btst        #13,&SP1
        seq         &SP2
```

➢ Engineering:KlicsCode:CompPict:Color2.a

```
        or.b        &SP1,&V
        and.w       &SP2,&V
        swap        &V
        move.w      &V,&SP1
        clr.b       &SP1
        andi.w      #$3FFF,&SP1
        sne         &SP1
        btst        #13,&SP1
        seq         &SP2
        or.b        &SP1,&V
        and.w       &SP2,&V
        swap        &V
*
        endm
*-----------------------------------
        macro
        OVERFLOW    &A, &B, &SP1, &SP2
*
*       move.l      #$FF00FF00,&SP1         ; sp1=mask
*       move.l      &A,&SP2                 ; sp2=ovov (A)
*       and.l       &SP1,&SP2               ; sp2=o0o0 (A)
*       lsr.l       #8,&SP2                 ; sp2=0o0o (A)
*       and.l       &B,&SP1                 ; sp1=o0o0 (B)
*       or.l        &SP2,&SP1               ; sp1=oooo (BABA)
        move.l      &A,&SP1
        or.l        &B,&SP1
        andi.l      #$FF00FF00,&SP1
        beq.s       @ok                     ; if no overflow
        clr.w       &SP2                    ; AND=0
        FIXOV       &A,&SP1,&SP2            ; A1 overflow
        FIXOV       &B,&SP1,&SP2            ; B1 overflow
@ok
*
        endm
*-----------------------------------
        macro
        MKRGB       &R, &G, &B, &ARGB
*
        lsl.l       #8,&G                   ; G=GOG0 (12)
        or.l        &B,&G                   ; G=GBGB (12)
        move.l      &R,&B                   ; B=0R0R (12)
        swap        &B                      ; B=0R0R (21)
        move.w      &G,&B                   ; B=0RGB (2)
        swap        &G                      ; G=GBGB (21)
        move.w      &G,&R                   ; R=0RGB (1)
        move.l      &R,&ARGB                ; *RGB++=rgb (1)
        move.l      &B,&ARGB                ; *RGB++=rgb (2)
*
        endm
*-----------------------------------
        macro
        DUPVAL      &V0, &V1
*
        move.w      &V0,&V1                 ; v1=v0
        swap        &V0
        move.w      &V1,&V0                 ; dup v0
        move.l      &V0,&V1                 ; dup v1
*
        endm
*-----------------------------------
        macro
        UV2RGB3     &AU,&AV
*
```

Engineering:KlicsCode:CompPict:Color2.a

```
*       d1 - ra, d2 - ga, d3 - ba, d4 - rb, d5 - gb/512, d6 - bb
*               =>
        move.w      #512,d5                 ; d5=512
        move.w      &AU,d2                  ; U=*AU++
        add.w       d2,d2                   ; U is 10(16) bits
        move.w      d2,d3                   ; ba=U
        add.w       d3,d2                   ; ga=2U
        add.w       d3,d2                   ; ga=3U
        add.w       d5,d3                   ; ba+=512
        DUPVAL      d3,d6                   ; ba=bb=BB
        asr.w       #4,d2                   ; ga=3U>>4
        move.w      &AV,d1                  ; V=*AV++
        add.w       d1,d2                   ; ga+=V
        add.w       d1,d1                   ; ra*=2
        add.w       d5,d1                   ; ra+=512
        DUPVAL      d1,d4                   ; ra=rb=RR
        sub.w       d2,d5                   ; gb=512-ga
        DUPVAL      d5,d2                   ; ga=gb=GG
*
        endm
*-----------------------------------
        if  &TYPE('seg')<>'UNDEFINED' then
        seg         &seg
        endif

YUV2RGB2    FUNC    EXPORT
*
PS      RECORD      8
pixmap  DS.L        1
Y       DS.L        1
U       DS.L        1
V       DS.L        1
area    DS.L        1
width   DS.L        1
cols    DS.L        1
        ENDR
*
LS      RECORD      0,DECR
inc     DS.L        1
width   DS.L        1
fend    DS.L        1
count   DS.L        1
LSize   EQU         *
        ENDR
*
*       a0 - Y0, a1 - Y1, a2 - U, a3 - V, a4 - pm0, a5 - pm1
*       d0..6 - used, d7 - count
*
        link        a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.pixmap(a6),a4        ; pm0=pixmap
        move.l      a4,a5                   ; pm1=pm0
        move.l      PS.Y(a6),a0             ; Y0=Yc
        move.l      a0,a1                   ; Y1=Y0
        move.l      PS.U(a6),a2             ; U=Uc
        move.l      PS.V(a6),a3             ; V=Vc
        move.l      PS.area(a6),d7          ; fend=area
        lsl.l       #2,d7                   ; fend<<=2
        add.l       a4,d7                   ; fend+=pm0
        move.l      d7,LS.fend(a6)          ; save fend
        move.l      PS.width(a6),d5         ; width=width
        move.l      d5,d7                   ; count=width
```

```
=       Engineering:KlicsCode:CompPict:Color2.a

        asr.l     #1,d7                 ; count>>=1
        subq.l    #1,d7                 ; count-=1
        move.l    d7,PS.width(a6)       ; save width
        add.l     d5,d5                 ; width*=2
        add.l     d5,a1                 ; Y1+=width
        add.l     d5,d5                 ; width*=2
        move.l    d5,LS.width(a6)       ; save width
        move.l    PS.cols(a6),d4        ; inc=cols
        lsl.l     #2,d4                 ; inc<<=2
        add.l     d4,a5                 ; pm1+=inc
        add.l     d4,d4                 ; cols*=2
        sub.l     d5,d4                 ; inc now 2*cols-width bytes
        move.l    d4,LS.inc(a6)         ; save inc
@do     UV2RGB3   (a2)+,(a3)+           ; uv2rgb(*U++,*V++)
        FETCHY    (a0)+,d0,d1,d2,d3     ; add Ya to RGB values
        FETCHY    (a1)+,d0,d4,d5,d6     ; add Yb to RGB values
        move.w    #$3FFF,d0             ; d0=mask
        lsr.l     #2,d1                 ; d1 8(16) bits
        and.w     d0,d1                 ; d1 masked
        lsr.l     #2,d2                 ; d2 8(16) bits
        and.w     d0,d2                 ; d2 masked
        lsr.l     #2,d3                 ; d3 8(16) bits
        and.w     d0,d3                 ; d3 masked
        lsr.l     #2,d4                 ; d4 8(16) bits
        and.w     d0,d4                 ; d4 masked
        lsr.l     #2,d5                 ; d5 8(16) bits
        and.w     d0,d5                 ; d5 masked
        lsr.l     #2,d6                 ; d6 8(16) bits
        and.w     d0,d6                 ; d6 masked
        move.l    d1,d0
        or.l      d2,d0
        or.l      d3,d0
        or.l      d4,d0
        or.l      d5,d0
        or.l      d6,d0
        andi.l    #$FF00FF00,d0
        bne.s     @over                 ; if overflow
@ok     MKRGB     d1,d2,d3,(a4)+        ; save RGBa
        MKRGB     d4,d5,d6,(a5)+        ; save RGBb
        dbf       d7,@do                ; while
        adda.l    LS.inc(a6),a4         ; pm0+=inc
        adda.l    LS.inc(a6),a5         ; pm1+=inc
        adda.l    LS.width(a6),a0       ; Y0+=width
        exg.l     a0,a1                 ; Y1<->Y0
        move.l    PS.width(a6),d7       ; count=width
        cmpa.l    LS.fend(a6),a4        ; pm0<fend
        blt.w     @do                   ; while

        movem.l   (a7)+,d4-d7/a3-a5     ; restore registers
        unlk      a6                    ; remove locals
        rts                             ; return
@over   move.l    d7,LS.count(a6)       ; save count
        clr.w     d7                    ; AND=0

        FIXOV     d1,d0,d7              ; A overflow
        FIXOV     d2,d0,d7              ; B overflow
        FIXOV     d3,d0,d7              ; A overflow
        FIXOV     d4,d0,d7              ; B overflow
        FIXOV     d5,d0,d7              ; A overflow
        FIXOV     d6,d0,d7              ; B overflow
        move.l    LS.count(a6),d7       ; restore count
        bra       @ok
```

Engineering:KlicsCode:CompPict:Color2.a

```
        ENDFUNC
*---------------------------------
        if  &TYPE('seg')#'UNDEFINED' then
        seg         &seg
        endif

GREY2Y  FUNC    EXPORT
*
PS      RECORD      8
pixmap  DS.L        1
Y       DS.L        1
area    DS.L        1
width   DS.L        1
cols    DS.L        1
        ENDR
*
*   d0 - vvvv, d1 - v0v1, d2 - v2v3, d3 - xor, d4 - width, d5 - inc, d6 - rowend,
*   a0 - pm, a1 - Y
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7,-(a7)             ; store registers
*
        move.l      PS.pixmap(a6),a0        ; pm=pixmap
        move.l      PS.Y(a6),a1             ; Y=Yc
        move.l      PS.area(a6),d7          ; fend=area
        add.l       a0,d7                   ; fend+=pm
        move.l      PS.width(a6),d4         ; width_b=width
        move.l      PS.cols(a6),d5          ; inc_b=cols
        sub.l       d4,d5                   ; inc_b-=width_b
        move.l      #$7F7F7F7F,d3           ; xor=$7F7F7F7F
@do1    move.l      a0,d6                   ; rowend=pm
        add.l       d4,d6                   ; rowend+=width_b
@do2    move.l      (a0)+,d0                ; vvvv=*pm
        eor.l       d3,d0                   ; vvvv is signed
        move.w      d0,d2                   ; d2=v2v3
        asr.w       #6,d2                   ; d2=v2 (10 bits)
        swap        d2                      ; d2=v2??-
        move.b      d0,d2                   ; d2=v2v3
        ext.w       d2                      ; v3 extended
        lsl.w       #2,d2                   ; d2=v2v3 (10 bits)
        swap        d0                      ; d0=v0v1
        move.w      d0,d1                   ; d1=v0v1
        asr.w       #6,d1                   ; d1=v0 (10 bits)
        swap        d1                      ; d1=v0??
        move.b      d0,d1                   ; d1=v0v1
        ext.w       d1                      ; v1 extended
        lsl.w       #2,d1                   ; d1=v0v1 (10 bits)
        move.l      d1,(a1)+                ; *Y=d1
        move.l      d2,(a1)+                ; *Y=d2
        cmpa.l      d6,a0                   ; rowend>pm
        blt.s       @do2                    ; while
        adda.l      d5,a0                   ; pm+=inc_b
        cmpa.l      d7,a0                   ; fend>pm
        blt.s       @do1                    ; while
*
        movem.l     (a7)+,d4-d7             ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*---------------------------------
        if  &TYPE('seg')#'UNDEFINED' then
        seg         &seg
```

➡ Engineering:KlicsCode:CompPict:Color2.a

```
        endif

Y2GREY  FUNC    EXPORT
*
PS      RECORD      8
pixmap  DS.L        1
Y       DS.L        1
height  DS.L        1
width   DS.L        1
cols    DS.L        1
        ENDR
*
*   d0- spare, d1 - v43, d2 - v21, d3 - spare, d4 - width, d5 - inc, d6 - count, d
*   a0 - pm, a1 - Y
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7,-(a7)             ; store registers
*
        move.l      PS.pixmap(a6),a0        ; pm=pixmap
        move.l      PS.Y(a6),a1             ; Y=Yc
        move.l      PS.height(a6),d7        ; long height
        subq.l      #1,d7                   ; height-=1
        move.l      PS.width(a6),d4         ; long width
        move.l      PS.cols(a6),d5          ; long inc=cols
        sub.l       d4,d5                   ; inc-=width
        lsr.l       #2,d4                   ; width>>=2 (read 4 values)
        subq.l      #1,d4                   ; width-=1
@do1    move.l      d4,d6                   ; count=width
@do2    move.l      (a1)+,d0                ; d0=x4x3
        move.l      (a1)+,d1                ; d1=x2x1
        move.l      #$01FF01FF,d2           ; d2=511
        move.l      d2,d3                   ; d3=511
        sub.l       d0,d2                   ; unsigned d2
        sub.l       d1,d3                   ; unsigned d3
        lsr.l       #2,d2
        lsr.l       #2,d3
        move.l      d2,d0
        or.l        d3,d0
        andi.l      #$3F003F00,d0
        bne.s       @over                   ; if no overflow
@ok     lsl.w       #8,d3                   ; d3=0210
        lsl.w       #8,d2                   ; d2=0430
        lsr.l       #8,d3                   ; d3=0021
        lsl.l       #8,d2                   ; d2=4300
        or.l        d3,d2                   ; d2=4321
        move.l      d2,(a0)+                ; *pm=d2
        dbf         d6,@do2                 ; while -1!=--count
        adda.l      d5,a0                   ; pm+=inc_b
        dbf         d7,@do1                 ; while -1!=--height
*
        movem.l     (a7)+,d4-d7             ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
@over   clr.w       d1                      ; AND=0
        FIXOV       d2,d0,d1                ; A overflow
        FIXOV       d3,d0,d1                ; B overflow
        bra.s       @ok
*
        ENDFUNC
*-----------------------------------
        macro
        GGG         &V,&SP1,&SP2,&AV
*
```

```
                Engineering:KlicsCode:CompPict:Color2.a

        move.l      &V,&SP2                 ; SP2=0102
        lsl.l       #8,&SP2                 ; SP2=1020
        or.l        &V,&SP2                 ; SP2=1122
        move.l      &V,&SP1                 ; SP1=0102
        swap        &SP1                    ; SP1=0201
        move.w      &SP2,&SP1               ; SP1=0222
        swap        &SP2                    ; SP2=2211
        move.w      &SP2,&V                 ; V=0111
        move.l      &V,&AV                  ; *pm=V
        move.l      &SP1,&AV                ; *pm=SP1
*
        endm
*-----------------------------------
        if  &TYPE('seg')<>'UNDEFINED' then
        seg         &seg
        endif

Y2GGG   FUNC    EXPORT
*
PS      RECORD      8
pixmap  DS.L        1
Y       DS.L        1
lines   DS.L        1
width   DS.L        1
cols    DS.L        1
        ENDR
*
*   d0 - v, d4 - width, d5 - inc, d6 - count, d7 - lines
*   a0 - pm, a1 - Y
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7,-(a7)             ; store registers
*
        move.l      PS.pixmap(a6),a0        ; pm=pixmap
        move.l      PS.Y(a6),a1             ; Y=Yc
        move.l      PS.lines(a6),d7         ; long lines
        subq.l      #1,d7                   ; lines-=1
        move.l      PS.width(a6),d4         ; long width
        move.l      PS.cols(a6),d5          ; inc=cols
        sub.l       d4,d5                   ; inc-=width
        lsl.l       #2,d5                   ; inc (bytes)
        lsr.l       #2,d4                   ; width>>=2
        subq.l      #1,d4                   ; width-=1
@dc1    move.l      d4,d6                   ; count=width
@dc2    move.l      (a1)+,d0                ; d0=x1x2 (10 bits signed)
        move.l      (a1)+,d1                ; d1=x3x4 (10 bits)
        move.l      #$02000200,d3           ; d3=plus
        add.l       d3,d0                   ; d0=x1x2 (unsigned)
        add.l       d3,d1                   ; d1=x3x4 (unsigned)
        lsr.l       #2,d0                   ; d0=x1x2 (10,8 bits)
        lsr.l       #2,d1                   ; d1=x3x4 (10,8 bits)
        move.w      #$3FFF,d2               ; d2=mask
        and.w       d2,d0                   ; mask d0
        and.w       d2,d1                   ; mask d1
        move.l      d0,d2
        or.l        d1,d2
        andi.l      #$FF00FF00,d2
        bne.s       @over                   ; if no overflow
@ok     GGG         d0,d2,d3,(a0)+
        GGG         d1,d2,d3,(a0)+
        dbf         d6,@dc2                 ; while -1!=--count
        adda.l      d5,a0                   ; pm+=inc_b
        dbf         d7,@dc1                 ; while -1!=--lines
```

```
                    ➡ Engineering:KlicsCode:CompPict:Color2.a

*
        movem.l     (a7)+,d4-d7             ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
over    clr.w       d3                      ; AND=0
        FIXOV       d0,d2,d3                ; A overflow
        FIXOV       d1,d2,d3                ; B overflow
        bra.w       @ok
*
        ENDFUNC
*---------------------------------
        macro
        MXRGB2      &R, &G, &B, &ARGB, &ROW, &XX
*
        lsl.l       #8,&G                   ; G=G0G0 (12)
        or.l        &B,&G                   ; G=GBGB (12)
        move.l      &R,&B                   ; B=0R0R (12)
        swap        &B                      ; B=0R0R (21)
        move.w      &G,&B                   ; B=0RGB (2)
        swap        &G                      ; G=GBGB (21)
        move.w      &G,&R                   ; R=0RGB (1)

        andi.l      #$FFFEFEFE,&R           ; 7 bits for interpolation
        andi.l      #$FFFEFEFE,&B           ; 7 bits for interpolation

        move.l      &R,&G                   ; G=RGB(1)
        add.l       &B,&G                   ; G+=RGB(2)
        lsr.l       #1,&G                   ; G/=2

        move.l      &B,&XX                  ; XX=RGB(2)
        sub.l       &R,&XX                  ; XX-=RGB(1)
        lsr.l       #1,&XX                  ; XX/=2
        add.l       &B,&XX                  ; XX+=B

        move.l      &R,(&ARGB)+             ; *RGB++=rgb (1)
        move.l      &G,(&ARGB)+             ; *RGB++=rgb (1.5)
        move.l      &B,(&ARGB)+             ; *RGB++=rgb (2)
        move.l      &B,(&ARGB)+             ; *RGB++=rgb (2.5)

        add.l       &ROW,&ARGB
        sub.l       #16,&ARGB

        move.l      &R,(&ARGB)+             ; *RGB++=rgb (1)
        move.l      &G,(&ARGB)+             ; *RGB++=rgb (1.5)
        move.l      &B,(&ARGB)+             ; *RGB++=rgb (2)
        move.l      &B,(&ARGB)+             ; *RGB++=rgb (2.5)

        sub.l       &ROW,&ARGB
*
        endm
*---------------------------------
        if  &TYPE('seg')#'UNDEFINED' then
        seg         &seg
        endif

YUV2RGB3    FUNC    EXPORT
*
PS      RECORD      0
pixmap  DS.L        1
Y       DS.L        1
U       DS.L        1
V       DS.L        1
area    DS.L        1
```

```
                    Engineering:KlicsCode:CompPict:Color2.a

width   DS.L        1
cols    DS.L        1
        ENDR
*
LS      RECORD      0,DECR
inc     DS.L        1
width   DS.L        1
fend    DS.L        1
count   DS.L        1
row     DS.L        1
LSize   EQU         *
        ENDR
*
*       a0 - Y0, a1 - Y1, a2 - U, a3 - V, a4 - pm0, a5 - pm1
*       d0..6 - used, d7 - count
*
        link        a6,#LS.LSize            ; inc, width, fend and rowend are loca
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.pixmap(a6),a4        ; pm0=pixmap
        move.l      a4,a5                   ; pm1=pm0
        move.l      PS.Y(a6),a0             ; Y0=Yc
        move.l      a0,a1                   ; Y1=Y0
        move.l      PS.U(a6),a2             ; U=Uc
        move.l      PS.V(a6),a3             ; V=Vc
        move.l      PS.area(a6),d7          ; fend=area
        lsl.l       #2,d7                   ; fend<<=2
        add.l       a4,d7                   ; fend+=pm0
        move.l      d7,LS.fend(a6)          ; save fend
        move.l      PS.width(a6),d5         ; width=width
        move.l      d5,d7                   ; count=width
        asr.l       #1,d7                   ; count>>=1
        subq.l      #1,d7                   ; count-=1
        move.l      d7,PS.width(a6)         ; save width
        add.l       d5,d5                   ; width*=2
        add.l       d5,a1                   ; Y1+=width
        add.l       d5,d5                   ; width*=2
        move.l      d5,LS.width(a6)         ; save width
        move.l      PS.cols(a6),d4          ; inc=cols
        lsl.l       #2,d4                   ; inc<<=2
        move.l      d4,LS.row(a6)           ;*NEW save row
        add.l       d4,a5                   ; pm1+=inc
        add.l       d4,a5                   ;*NEW pm1+=inc
        add.l       d4,d4                   ; cols*=2
        add.l       d4,d4                   ;*NEW cols*=2
        sub.l       d5,d4                   ; inc now 4*cols-width bytes
        sub.l       d5,d4                   ;*NEW  inc now 4*cols-width bytes (wid
        move.l      d4,LS.inc(a6)           ; save inc
@do     UV2RGB3     (a2)+,(a3)+             ; uv2rgb(*U++,*V++)

        FETCHY      (a0)+,d0,d1,d2,d3       ; add Ya to RGB values
        FETCHY      (a1)+,d0,d4,d5,d6       ; add Yb to RGB values

        move.w      #$3FFF,d0               ; d0=mask
        lsr.l       #2,d1                   ; d1 8(16) bits
        and.w       d0,d1                   ; d1 masked
        lsr.l       #2,d2                   ; d2 8(16) bits
        and.w       d0,d2                   ; d2 masked
        lsr.l       #2,d3                   ; d3 8(16) bits
        and.w       d0,d3                   ; d3 masked
        lsr.l       #2,d4                   ; d4 8(16) bits
        and.w       d0,d4                   ; d4 masked
        lsr.l       #2,d5                   ; d5 8(16) bits
```

```
                    Engineering:KlicsCode:CompPict:Color3.a
                    =
        and.w       d0,d5                   ; d5 masked
        lsr.l       #2,d6                   ; d6 8(16) bits
        and.w       d0,d6                   ; d6 masked

        move.l      d1,d0
        or.l        d2,d0
        or.l        d3,d0
        or.l        d4,d0
        or.l        d5,d0
        or.l        d6,d0
        andi.l      #$FF00FF00,d0
        bne.w       @over                   ; if overflow

@ok     MKRGB2      d1,d2,d3,a4,LS.row(a6),d0   ;*NEW save RGBa
        MKRGB2      d4,d5,d6,a5,LS.row(a6),d0   ;*NEW save RGBb
        dbf         d7,@do                  ; while
        adda.l      LS.inc(a6),a4           ; pm0+=inc
        adda.l      LS.inc(a6),a5           ; pm1+=inc
        adda.l      LS.width(a6),a0         ; Y0+=width
        exg.l       a0,a1                   ; Y1<->Y0
        move.l      PS.width(a6),d7         ; count=width
        cmpa.l      LS.fend(a6),a4          ; pm0<fend
        blt.w       @do                     ; while

        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
@over   move.l      d7,LS.count(a6)         ; save count
        clr.w       d7                      ; AND=0
        FIXOV       d1,d0,d7                ; A overflow
        FIXOV       d2,d0,d7                ; B overflow
        FIXOV       d3,d0,d7                ; A overflow
        FIXOV       d4,d0,d7                ; B overflow
        FIXOV       d5,d0,d7                ; A overflow
        FIXOV       d6,d0,d7                ; B overflow
        move.l      LS.count(a6),d7         ; restore count
        bra         @ok

        ENDFUNC
;-----------------------------------
        macro
        FETCHY2     &AY, &Y, &R, &G, &B

        move.l      &AY,&Y                  ;Y
        asr.w       #2,&Y
        swap        &Y
        asr.w       #2,&Y                   ;Y is       -128 to +127
        swap        &Y                      ;RED, Get (Y- 2V + 512) for Red = (Y +
        add.l       &Y,&R                   ;GREEN, Get (Y + (512 - (6U/16)) - V)
        add.l       &Y,&G                   ;BLUE,Get (Y + (2U + 512) for Blue = (
        add.l       &Y,&B

        endm
;-----------------------------------
        macro
        UV2RGB4     &AU,&AV

        move.w      &AU,d2              ; U
        and.w       #$03FF,d2
        move.l      (a6,d2.w*8),d3          ;BLUE,Get (2U + 512)/4 for Blue = (Y +
        move.l      d3,d6                   ;Dup for second pair
        move.l      4(a6,d2.w*8),d5         ;GREEN, Get (512 - (6U/16))/4 for Gree
        move.w      &AV,d1              ; V
```

Engineering:KlicsCode:CompPict:Color2.a

```
        move.w      d1,d4
        asr.w       #2,d1
        sub.w       d1,d5                   ;GREEN. Get (512 - (6U/16) - V)/4 for
        move.w      d5,d2
        swap        d5
        move.w      d2,d5
        move.l      d5,d2                   ;Dup for second pair

        and.w       #$03FF,d4
        move.l      (a6,d4.w*8),d4          ;RED. Get (2V + 512)/4 for Red = (Y +
        move.l      d4,d1
*
        endm
*-----------------------------------

MKRGB2SUB   FUNC    EXPORT
*
        MKRGB2      d1,d2,d3,a4,d7,d0   ;*NEW save RGBa
        MKRGB2      d4,d5,d6,a5,d7,d0   ;*NEW save RGBb
        rts
*
        ENDFUNC

OVERSUB FUNC        EXPORT
*
        move.l      d1,d0
        or.l        d2,d0
        or.l        d3,d0
        or.l        d4,d0
        or.l        d5,d0
        or.l        d6,d0
        andi.l      #$FF00FF00,d0
        bne.s       @over                   ; if overflow
@ok     rts
@over   move.l      d7,-(sp)                ; save count
        clr.w       d7                      ; AND=0
        FIXOV       d1,d0,d7                ; A overflow
        FIXOV       d2,d0,d7                ; B overflow
        FIXOV       d3,d0,d7                ; A overflow
        FIXOV       d4,d0,d7                ; B overflow
        FIXOV       d5,d0,d7                ; A overflow
        FIXOV       d6,d0,d7                ; B overflow
        move.l      (sp)+,d7                ; restore count
        bra         @ok
*
        ENDFUNC

UV2RGB4SUB  FUNC    EXPORT
*
        UV2RGB4     (a2)+,(a3)+             ; uv2rgb(*U++,*V++)
        rts
*
        ENDFUNC

FETCHY2SUB  FUNC    EXPORT
*
        FETCHY2     (a0)+,d0,d1,d2,d3       ; add Ya to RGB values
        FETCHY2     (a1)+,d0,d4,d5,d6       ; add Yb to RGB values
        rts
*
        ENDFUNC

        if  $TYPE('seg')='UNDEFINED' then
```

```
                    Engineering:KlicsCode:CompPict:Color2.a

            seg         &seg
            endif

YUV2RGB5    FUNC        EXPORT
*
PS          RECORD      0
Table       DS.L        1
pixmap      DS.L        1
Y           DS.L        1
U           DS.L        1
V           DS.L        1
area        DS.L        1
width       DS.L        1
cols        DS.L        1
            ENDR
*
LS          RECORD      0,DECR
inc         DS.L        1
width       DS.L        1
fend        DS.L        1
count       DS.L        1
row         DS.L        1
LSize       EQU         *
            ENDR
*
*           a0 - Y0, a1 - Y1, a2 - U, a3 - V, a4 - pm0, a5 - pm1
*           d0..6 - used, d7 - count
*
            link        a6,#LS.LSize            ; inc, width, fend and rowend are loca
            movem.l     d4-d7/a2-a5,-(a7)       ; store registers
*
            move.l      PS.pixmap(a6),a4        ; pm0=pixmap
            move.l      a4,a5                   ; pm1=pm0
            move.l      PS.Y(a6),a0             ; Y0=Yc
            move.l      a0,a1                   ; Y1=Y0
            move.l      PS.U(a6),a2             ; U=Uc
            move.l      PS.V(a6),a3             ; V=Vc
            move.l      PS.area(a6),d7          ; fend=area
            lsl.l       #2,d7                   ; fend<<=2
            add.l       a4,d7                   ; fend+=pm0
            move.l      d7,LS.fend(a6)          ; save fend
            move.l      PS.width(a6),d5         ; width=width
            move.l      d5,d7                   ; count=width
            asr.l       #1,d7                   ; count>>=1
            subq.l      #1,d7                   ; count-=1
            move.l      d7,PS.width(a6)         ; save width

            add.l       d5,d5                   ; width*=2
            add.l       d5,a1                   ; Y1+=width
            add.l       d5,d5                   ; width*=2
            move.l      d5,LS.width(a6)         ; save width
            move.l      PS.cols(a6),d4          ; inc=cols
            lsl.l       #2,d4                   ; inc<<=2
            move.l      d4,LS.row(a6)           ;*NEW save row
            add.l       d4,a5                   ; pm1+=inc
            add.l       d4,a5                   ;*NEW pm1+=inc
            add.l       d4,d4                   ; cols*=2
            add.l       d4,d4                   ;*NEW cols*=2
            sub.l       d5,d4                   ; inc now 4*cols-width bytes
            sub.l       d5,d4                   ;*NEW  inc now 4*cols-width bytes (wid
            move.l      d4,LS.inc(a6)           ; save inc

9dc         move.l      d7,-(sp)
```

```
                    ➡ Engineering:KicsCode:CompPict:Color2.a

          move.l    a6,-(sp)
          move.l    LS.row(a6),d7
          move.l    PS.Table(a6),a6
          UV2RGB4   (a2)+,(a3)+              ; uv2rgb(*U++,*V++)

          FETCHY1   (a0)+,d0,d1,d2,d3        ; add Ya to RGB values
          FETCHY2   (a1)+,d0,d4,d5,d6        ; add Yb to RGB values

          move.l    d1,d0
          or.l      d2,d0
          or.l      d3,d0
          or.l      d4,d0
          or.l      d5,d0
          or.l      d6,d0
          andi.l    #$FF00FF00,d0
          bne.w     @over                    ; if overflow

@ok       MKRGB2    d1,d2,d3,a4,d7,d0   ;*NEW save RGBa
          MKRGB2    d4,d5,d6,a5,d7,d0   ;*NEW save RGBb
          move.l    (sp)+,a6
          move.l    (sp)+,d7

          dbf       d7,@do                   ; while

          adda.l    LS.inc(a6),a4            ; pm0+=inc
          adda.l    LS.inc(a6),a5            ; pm1+=inc
          adda.l    LS.width(a6),a0          ; Y0+=width
          exg.l     a0,a1                    ; Y1<->Y0
          move.l    PS.width(a6),d7          ; count=width
          cmpa.l    LS.fend(a6),a4           ; pm0<fend
          blt.s     @do                      ; while

          movem.l   (a7)+,d4-d7/a3-a5        ; restore registers
          unlk      a6                       ; remove locals
          rts                                ; return
@over     move.l    d7,LS.count(a6)          ; save count
          clr.w     d7                       ; AND=0
          FIXOV     d1,d0,d7                 ; A overflow
          FIXOV     d2,d0,d7                 ; B overflow
          FIXOV     d3,d0,d7                 ; A overflow
          FIXOV     d4,d0,d7                 ; B overflow
          FIXOV     d5,d0,d7                 ; A overflow
          FIXOV     d6,d0,d7                 ; B overflow
          move.l    LS.count(a6),d7          ; restore count
          bra       @ok

          ENDFUNC
;-----------------------------------
          END
```

Engineering:KlicsCode:CompPict:Clut.c

```
/*********************************
 *
 *  © Copyright 1993 KLICS Limited
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 *
 *  Written by: Adrian Lewis
 *
 *********************************/
/*
    Analyse CLUT setup and pick appropriate
    YUV->RGB converter/display driver. Create
    any tables necessary.
*/

#include <QuickDraw.h>
#include <Memory.h>

#define Y_LEVELS    64
#define UV_LEVELS   16

#define absv(v) ((v)<0?-(v):(v))
#define NewPointer(ptr,type,size) \
    saveZone=GetZone(); \
    SetZone(SystemZone()); \
    if (nil==(ptr=(type)NewPtr(size))) { \
        SetZone(ApplicZone()); \
        if (nil==(ptr=(type)NewPtr(size))) { \
            SetZone(saveZone); \
            return(MemoryError()); \
        } \
    } \
    SetZone(saveZone);

typedef struct {
    char    y, u, v;
} YUV_Clut;

/*
unsigned char *
ColourClut(CTabHandle clut)
{
    int     size, y, u, v, r, g, b, i;
    unsigned char *table;
    YUV_Clut    *yuv_clut;

    size=(*clut)->ctSize;
    table=(unsigned char *)NewPtr(Y_LEVELS*UV_LEVELS*UV_LEVELS);
    yuv_clut=(YUV_Clut *)NewPtr(size*sizeof(YUV_Clut));

    for(i=0;i<=size;i++) {
        r=((*clut)->ctTable[i].rgb.red>>8)-128;
        g=((*clut)->ctTable[i].rgb.green>>8)-128;
        b=((*clut)->ctTable[i].rgb.blue>>8)-128;

        yuv_clut[i].y= (306*r + 601*g + 117*b)>>10;
        yuv_clut[i].u= (512*r - 429*g - 83*b)>>10;
        yuv_clut[i].v= (-173*r - 339*g + 512*b)>>10;
    }
    for(y=-Y_LEVELS/2;y<Y_LEVELS/2-1;y++)
    for(u=-UV_LEVELS/2;u<UV_LEVELS/2-1;u++)
    for(v=-UV_LEVELS/2;v<UV_LEVELS/2-1;v++) {
        int     index,error,error2,points, Y, U, V;
```

Engineering:KlicsCode:CompPict:Clut.c

```
        Y=y<<4;
        U=u<<5;
        V=v<<5;

        index=0;
        error=131072;
        error2=131072;
        points=0;
        for(i=0;i<=size;i++) {
            int pts=0, err=0;

            if (yuv_clut[i].y>=Y && yuv_clut[i].y<Y+16)
                pts+=1;
            err+=absv(yuv_clut[i].y-Y);

            if (yuv_clut[i].u>=U && yuv_clut[i].u<U+32)
                pts+=1;
            err+=absv(yuv_clut[i].u-U);

            if (yuv_clut[i].v>=V && yuv_clut[i].v<V+32)
                pts+=1;
            err+=absv(yuv_clut[i].v-V);

            if (pts>points || (pts==points && err<error)) {
                error=err;
                index=i;
                points=pts;
            }
        }
        i=((y&0x1F)<<8)|((u&0xF)<<4)|(v&0xF);
        table[i]=(unsigned char)index;
    }
    DisposePtr((Ptr)yuv_clut);
    return table;
}*/

typedef union {
    long    pixel;
    unsigned char   rgb[4];
} Pixel;
/*
unsigned long *
ColourClut(CTabHandle clut)
{
    long    size, y, u, v, r, g, b, ro, go, bo,i;
    Pixel   *table;

    size=(*clut)->ctSize;
    table=(Pixel *)NewPtr(Y_LEVELS*UV_LEVELS*UV_LEVELS*sizeof(long));

    for(y=-Y_LEVELS/2;y<Y_LEVELS/2-1;y++)
    for(u=-UV_LEVELS/2;u<UV_LEVELS/2-1;u++)
    for(v=-UV_LEVELS/2;v<UV_LEVELS/2-1;v++) {
        Pixel   px;
        long    base, dith;

        r = 32768L + ((y<<9) + 1436L*u <<2);
        g = 32768L + ((y<<9) - 731L*u - 352L*v <<2);
        b = 32768L + ((y<<9) + 1815L*v <<2);

        r=r<0?0:r>65534?65534:r;
        g=g<0?0:g>65534?65534:g;
        b=b<0?0:b>65534?65534:b;
```

➡ Engineering:KilcsCode:CompPict:Clut.c

```
        rc=r%13107; r=r/13107;
        gc=g%13107; g=g/13107;
        bc=b%13107; b=b/13107;

        base=215-(36*r+6*g-b);

        dith=base-(rc>2621?36:0)-(gc>7863?6:0)-(bc>10484?1:0);
        px.rgb[0]=dith==215?255:dith;

        dith=base-(rc>5242?36:0)-(gc>10484?6:0)-(bc>2621?1:0);
        px.rgb[1]=dith==215?255:dith;

        dith=base-(rc>7863?36:0)-(gc>2621?6:0)-(bc>5242?1:0);
        px.rgb[2]=dith==215?255:dith;

        dith=base-(rc>10484?36:0)-(gc>5242?6:0)-(bc>7863?1:0);
        px.rgb[3]=dith==215?255:dith;

        i=((y&0x3F)<<8)|((u&0xF)<<4)|(v&0xF);

        table[i].pixel=px.pixel;
    }
    return (unsigned long*)table;
}*/

typedef struct {
    long    red, green, blue;
} RGBError;

OSErr ColourClut(Pixel **table)
{
    long    y, u, v, r, g, b, i;
    RGBError    *err;
    THz     saveZone;

    NewPointer((*table.Pixel*),Y_LEVELS*UV_LEVELS*UV_LEVELS*sizeof(long)); /* 64k ta
    NewPointer(err,RGBError*,Y_LEVELS*UV_LEVELS*UV_LEVELS*sizeof(RGBError));

    for(i=0;i<4;i++)
    for(y=-Y_LEVELS/2;y<Y_LEVELS/2;y++)
    for(u=-UV_LEVELS/2;u<UV_LEVELS/2;u++)
    for(v=-UV_LEVELS/2;v<UV_LEVELS/2;v++) {
        RGBColor    src, dst;
        long    index,in;

        index=((y&0x3F)<<8)|((u&0xF)<<4)|(v&0xF);

        r = 32768L + ((y<<9) + (1436L*u) <<2);
        g = 32768L + ((y<<9) - (731L*u) - (352L*v) <<2);
        b = 32768L + ((y<<9) + (1815L*v) <<2);

        if (i>0) {
            r-=err[index].red;
            g-=err[index].green;
            b-=err[index].blue;
        }

        src.red=r<0?0:r>65534?65534:r;
        src.green=g<0?0:g>65534?65534:g;
        src.blue=b<0?0:b>65534?65534:b;

        (*table)[index].rgb[i]=(unsigned char)Color2Index(&src);
```

➡ Engineering:KlicsCode:CompPict:Clut.c

```
        Index2Color((*table)[index].rgb[i],&dst);
        err[index].red=dst.red-src.red;
        err[index].green=dst.green-src.green;
        err[index].blue=dst.blue-src.blue;
    }
    DisposePtr((Ptr)err);
    return(noErr);
}

typedef struct {
    short   pel[2];
} Pix16;

typedef struct {
    unsigned char   pel[4];
} Pix8;

#define YS  64
#define UVS 32

OSErr Colour8(Pix8 **table)
{
    long    y, u, v, r, g, b, i;
    RGBError    *err;
    THz     save2one;

    NewPointer(*table,Pix8*,YS*UVS*UVS*sizeof(Pix8)); /* 128k table */
    NewPointer(err,RGBError*,YS*UVS*UVS*sizeof(RGBError));

    for(i=0;i<4;i++)
    for(y=-YS/2;y<YS/2;y++)
    for(u=-UVS/2;u<UVS/2;u++)
    for(v=-UVS/2;v<UVS/2;v++) {
        RGBColor    src, dst;
        long    index;

        index=(y<<10)|((u&0x1F)<<5)|(v&0x1F);

        r = 32768L + ((y<<10) + (1436L*u) <<1);
        g = 32768L + ((y<<10) - (731L*u) - (352L*v) <<1);
        b = 32768L + ((y<<10) + (1815L*v) <<1);

        if (i>0) {
            r-=err[32768+index].red;
            g-=err[32768+index].green;
            b-=err[32768+index].blue;
        }

        src.red=r<0?0:r>65534?65534:r;
        src.green=g<0?0:g>65534?65534:g;
        src.blue=b<0?0:b>65534?65534:b;

        (*table)[32768+index].pel[i]=(unsigned char)Color2Index(&src);
        Index2Color((*table)[32768+index].pel[i],&dst);

        err[32768+index].red=dst.red-src.red;
        err[32768+index].green=dst.green-src.green;
        err[32768+index].blue=dst.blue-src.blue;
    }
    DisposePtr((Ptr)err);
    return(noErr);
}
```

Engineering:KillsCode:CompPict:Clut.c

```
OSErr Colour16(Pix16 **table)
{
    long    y, u, v, r, g, b, i;
    RGBError    *err;
    THz     saveZone;

    NewPointer((*table,Pix16*,YS*UVS*UVS*sizeof(Pix16)); /* 128k table */
    NewPointer(err,RGBError*,YS*UVS*UVS*sizeof(RGBError));

    for(i=0;i<2;i++)
    for(y=-YS/2;y<YS/2;y++)
    for(u=-UVS/2;u<UVS/2;u++)
    for(v=-UVS/2;v<UVS/2;v++) {
        RGBColor    src, dst;
        long    index;

        index=(y<<10)|((u&0x1F)<<5)|(v&0x1F);

        r = 32768L + ((y<<10) + (1436L*u) <<1);
        g = 32768L + ((y<<10) - (731L*u) - (352L*v) <<1);
        b = 32768L + ((y<<10) + (1815L*v) <<1);

        if (i>0) {
            r-=err[32768+index].red;
            g-=err[32768+index].green;
            b-=err[32768+index].blue;
        }

        src.red=r<0?0:r>65534?65534:r;
        src.green=g<0?0:g>65534?65534:g;
        src.blue=b<0?0:b>65534?65534:b;

        dst.red= src.red&0xF800;
        dst.green= src.green&0xF800;
        dst.blue= src.blue&0xF800;

        (*table)[32768+index].pel[i]=(dst.red>>1)|(dst.green>>6)|(dst.blue>>11);

        err[32768+index].red=dst.red-src.red;
        err[32768+index].green=dst.green-src.green;
        err[32768+index].blue=dst.blue-src.blue;
    }
    DisposePtr((Ptr)err);
    return(noErr);
}

Boolean
GreyClut(CTabHandle clut)
{
    Boolean result=true;
    int     i, size;

    size=(*clut)->ctSize;
    for(i=0;i<=size && result;i++) {
        int     r,g,b;

        r=(*clut)->ctTable[i].rgb.red;
        g=(*clut)->ctTable[i].rgb.green;
        b=(*clut)->ctTable[i].rgb.blue;

        result=(r==g && g==b);
    }
```

Engineering:KlicsCode:CompPict:Clut.c

```
return result;
```

Engineering:KlicsCode:CompPict:Bits3.h

```
/*****************************
 *
 *  © Copyright 1993 KLICS Limited
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 *
 *  Written by: Adrian Lewis
 *
 *****************************/
/*
    Bits3.h: fast bit read/write definitions

    buf_use     define static variables
    buf_winit   initialise vars for write
    buf_rinit   initialise vars for read
    buf_set     set current bit
    buf_get     get current bit
    buf_winc    increment write buffer
    buf_rinc    increment read buffer
    buf_size    fullness of buffer in bytes
    buf_flush   flush buffer

    User defined macro/function buf_over must be defined in case of buffer overflo
*/

typedef struct {
    unsigned long   *buf;
    union   {
        unsigned long   mask;
        long    bno;
    } index;
    unsigned long   *ptr, data, size;
} Buffer, *Buf;

#define buf_winit(buf) \
    buf->index.mask=0x80000000; \
    buf->ptr=&buf->buf[0]; \
    buf->data=0;

#define buf_rinit(buf) \
    buf->index.bno=0; \
    buf->ptr=&buf->buf[0];

#define buf_set(buf) \
    buf->data |= buf->index.mask;

#define buf_get(buf) \
    0!=(buf->data & (1<<buf->index.bno) )

#define buf_winc(buf) \
    if (buf->index.mask==1) { \
        *buf->ptr=buf->data; \
        buf->data=0; \
        buf->index.mask=0x80000000; \
        buf->ptr++; \
    } else buf->index.mask >>= 1;

#define buf_rinc(buf) \
    if (--(buf->index.bno)<0) { \
        buf->data=*buf->ptr++; \
        buf->index.bno=31; \
    };

/* buf_size only valid after buf_flush */
```

➧ Engineering:KlicsCode:CompPict:Bits3.h

```
#define buf_size(buf) \
    (unsigned char *)buf->ptr-(unsigned char *)&buf->buf[0]

#define buf_flush(buf) \
    if (buf->index.mask!=0x80000000) { \
        buf->data|=buf->index.mask-1; \
        *buf->ptr=buf->data; \
        buf->ptr++; \
    }
```

Engineering:KLICSCode:CompPict:Bits3.e

```
*---------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*---------------------------------
*
*   68000 Bit buffer code (Bits2.h)
*
*---------------------------------
*
*   Macros:
*       buf_winit   &ptr,&data,&mask,&buf
*       buf_rinit   &ptr,&bno,&buf
*       buf_set     &data,&mask
*       buf_get     &data,&bno
*       buf_winc    &ptr,&data,&mask
*       buf_rinc    &ptr,&data,&index
*       buf_flush   &ptr,&data,&mask
*
*---------------------------------
        macro
        buf_winit   &ptr,&data,&mask,&buf
*
        move.l      #$80000000,&mask        ; mask=100..
        move.l      &buf,&ptr               ; ptr=buf
        clr.l       &data                   ; data=0
*
        endm
*---------------------------------
        macro
        buf_rinit   &ptr,&bno,&buf
*
        clr.b       &bno                    ; bno=0
        move.l      &buf,&ptr               ; ptr=buf
*
        endm
*---------------------------------
        macro
        buf_set     &data,&mask
*
        or.l        &mask,&data             ; data |= mask
*
        endm
*---------------------------------
        macro
        buf_get     &data,&bno
*
        subq.b      #1,&bno
        btst        &bno,&data
*
        endm
*---------------------------------
        macro
        buf_winc    &ptr,&data,&mask
*
        lsr.l       #1,&mask                ; mask>>=1
        bne.s       @cont                   ; if non-zero continue
        move.l      &data,(&ptr)+           ; *ptr++=data
        clr.l       &data                   ; data=0
        move.l      #$80000000,&mask        ; mask=100...
```

Engineering:KlicsCode:CompPict:Bits3.a

```
@cont
*
        endm
*--------------------------------
        macro
        buf_rinc    &ptr,&data,&bno
*
        cmpi.b      #16,&bno
        bge.s       @cont
        swap        &data
        move.w      (&ptr)+,&data           ; data=*ptr++
        add.b       #16,&bno                ; bno+=16
@cont
*
        endm
*--------------------------------
        macro
        buf_flush   &ptr,&data,&mask
*
        cmp.l       #$80000000,&mask        ; mask-80000000?
        beq.s       @cont                   ; if buffer empty continue
        move.l      &data,(&ptr)+           ; *ptr++=data
*
        endm
*--------------------------------
```

➢ Engineering:KlicsCode:CompPict:Backward.c

```
/*****************************
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 *****************************/
/*
    Extra fast Backward\convolver
    New wavelet coeffs : 3 5 1 1, 1 2 1, 1 1

    Optimized for speed:
        dirn - False
        src/dst octave == 0
*/

#define BwdS0(addr0,dAG,dAH,dBH) \
    v=*(short *)addr0; \
    dAG= -v; \
    dAH= v; \
    dBH= v<<1; \

#define BwdS1(addr1,addr0,dAG,dAH,dBH) \
    v=*(short *)addr1; \
    dBH+= v>>1; \
    dAG+= v+(v&=v<<1); \
    dAH-= v+(v&<<=1); \
    *(short *)addr0=dBH>>1;

#define Bwd2(addr2,dAG,dAH,dBG,dBH) \
    v=*(short *)addr2; \
    dBG=  -v; \
    dBH=  v; \
    dAH+= v+(v&=v<<1); \
    dAG+= v+(v&<<=1);

#define Bwd3(addr3,addr2,addr1,dAG,dAH,dBG,dBH) \
    v=*(short *)addr3; \
    dAH+= v; \
    dAG+= v; \
    dBG+= v+(v&=v<<1); \
    dBH-= v+(v&<<=1); \
    *(short *)addr1=(dAH-1)>>2; \
    *(short *)addr2=(dAG-1)>>2;

#define Bwd0(addr0,dAG,dAH,dBG,dBH) \
    v=*(short *)addr0; \
    dAG=  -v; \
    dAH=  v; \
    dBH+= v+(v&=v<<1); \
    dBG+= v+(v&<<=1);

#define Bwd1(addr1,addr0,addr3,dAG,dAH,dBG,dBH) \
    v=*(short *)addr1; \
    dBH+= v; \
    dBG+= v; \
    dAG+= v+(v&=v<<1); \
    dAH-= v+(v&<<=1); \
    *(short *)addr3=(dBH+1)>>2; \
    *(short *)addr0=(dBG+1)>>2;

#define BwdE2(addr2,dAG,dAH,dBH) \
```

Engineering:KlicsCode:CompPict:Backward.c

```
    v=*(short *)addr2; \
    dBH= vs=v<<1; \
    dAH+= v+(vs=v<<1); \
    dAG+= v+(vs<<=1);

#define BwdE3(addr3,addr2,addr1,dAG,dAH,dBH) \
    v=*(short *)addr3; \
    dAH+= v; \
    dAG+= v; \
    dBH+= v+(vs=v<<1); \
    dBH+= v+(vs<<=1); \
    *(short *)addr1=(dAH+1)>>2; \
    *(short *)addr2=(dAG+1)>>2; \
    *(short *)addr3=dBH>>1;

#define Bwd(base,end,inc) \
    addr0=base; \
    addr3=addr0-(inc>>2); \
    addr2=addr3-(inc>>2); \
    addr1=addr2-(inc>>2); \
    BwdS0(addr0,dAG,dAH,dBH); \
    addr1+=inc; \
    BwdS1(addr1,addr0,dAG,dAH,dBH); \
    addr2+=inc; \
    while(addr2<end) { \
        Bwd2(addr2,dAG,dAH,dBG,dBH); \
        addr3+=inc; \
        Bwd3(addr3,addr2,addr1,dAG,dAH,dBG,dBH); \
        addr0+=inc; \
        Bwd0(addr0,dAG,dAH,dBG,dBH); \
        addr1+=inc; \
        Bwd1(addr1,addr0,addr3,dAG,dAH,dBG,dBH); \
        addr2+=inc; \
    } \
    BwdE2(addr2,dAG,dAH,dBH); \
    addr3+=inc; \
    BwdE3(addr3,addr2,addr1,dAG,dAH,dBH);

#define BwdS0r2(addr0,dAG,dAH,dBH) \
    v=*(short *)addr0; \
    dAG= 0; \
    dAH= v; \
    dBH= v; \

#define BwdS1r2(addr1,addr0,dAG,dAH,dBH) \
    v=*(short *)addr1; \
    dBH+= v>>2; \
    dAG+= v; \
    dAH+= v<<1; \
    *(short *)addr0=dBH;

#define Bwd2r2(addr2,dAG,dAH,dBG,dBH) \
    v=*(short *)addr2; \
    dBG= 0; \
    dBH= v; \
    dAH+= v; \
    dAG+= v<<1;

#define Bwd3r2(addr3,addr2,addr1,dAG,dAH,dBG,dBH) \
    v=*(short *)addr3; \
    dAH+= 0; \
    dAG+= v; \
    dBG+= v; \
```

Engineering:KicsCode:CompPict:Backward.c

```
    dBH-= v<<1; \
    *(short *)addr1=dAH>>1; \
    *(short *)addr2=dAG>>1;

#define Bwd0r2(addr0,dAG,dAH,dBG,dBH) \
    v=*(short *)addr0; \
    dAG= 0; \
    dAH= v; \
    dBH-= v; \
    dBG-= v<<1;

#define Bwd1r2(addr1,addr0,addr3,dAG,dAH,dBG,dBH) \
    v=*(short *)addr1; \
    dBH-= 0; \
    dBG-= v; \
    dAG+= v; \
    dAH-= v<<1; \
    *(short *)addr3=dBH>>1; \
    *(short *)addr0=dBG>>1;

#define Bwd2r2(addr2,dAG,dAH,dBH) \
    v=*(short *)addr2; \
    dBH= v; \
    dAH+= v; \
    dAG+= v<<1;

#define Bwd3r2(addr3,addr2,addr1,dAG,dAH,dBH) \
    v=*(short *)addr3; \
    dAH+= 0; \
    dAG+= v; \
    dBH-= v; \
    dBH-= v<<1; \
    *(short *)addr1=dAH>>1; \
    *(short *)addr2=dAG>>1; \
    *(short *)addr3=dBH;

#define Bwdr2(base,end,inc) \
    addr0=base; \
    addr3=addr0-(inc>>2); \
    addr2=addr3-(inc>>2); \
    addr1=addr2-(inc>>2); \
    Bwd0r2(addr0,dAG,dAH,dBH); \
    addr1+=inc; \
    Bwd1r2(addr1,addr0,dAG,dAH,dBH); \
    addr2+=inc; \
    while(addr2<end) { \
        Bwd2r2(addr2,dAG,dAH,dBG,dBH); \
        addr3+=inc; \
        Bwd3r2(addr3,addr2,addr1,dAG,dAH,dBG,dBH); \
        addr0+=inc; \
        Bwd0r2(addr0,dAG,dAH,dBG,dBH); \
        addr1+=inc; \
        Bwd1r2(addr1,addr0,addr3,dAG,dAH,dBG,dBH); \
        addr2+=inc; \
    } \
    Bwd2r2(addr2,dAG,dAH,dBH); \
    addr3+=inc; \
    Bwd3r2(addr3,addr2,addr1,dAG,dAH,dBH);

#define Bwd0r3(addr0,dAG,dAH,dBH) \
    v=*(short *)addr0; \
    dAG= 0; \
    dAH= 0; \
```

Engineering:KlicsCode:CompPict:Backward.c

```
    dBH= v>>1; \

#define BwdS1r3(addr1,addr0,dAG,dAH,dBH) \
    v=*(short *)addr1; \
    dBH+= v>>1; \
    dAG+= v; \
    dAH-= v; \
    *(short *)addr0=dBH<<1;

#define Bwd2r3(addr2,dAG,dAH,dBG,dBH) \
    v=*(short *)addr2; \
    dBG=  0; \
    dBH=  0; \
    dAH-= v; \
    dAG+= v;

#define Bwd3r3(addr3,addr2,addr1,dAG,dAH,dBG,dBH) \
    v=*(short *)addr3; \
    dAH+= 0; \
    dAG+= 0; \
    dBG+= v; \
    dBH-= v; \
    *(short *)addr1=dAH; \
    *(short *)addr2=dAG;

#define Bwd0r3(addr0,dAG,dAH,dBG,dBH) \
    v=*(short *)addr0; \
    dAG=  0; \
    dAH=  0; \
    dBH+= v; \
    dBG+= v;

#define Bwd1r3(addr1,addr0,addr3,dAG,dAH,dBG,dBH) \
    v=*(short *)addr1; \
    dBH+= 0; \
    dBG+= 0; \
    dAG+= v; \
    dAH-= v; \
    *(short *)addr3=dBH; \
    *(short *)addr0=dBG;

#define BwdF2r3(addr2,dAG,dAH,dBH) \
    v=*(short *)addr2; \
    dBH=  v>>1; \
    dAH+= v; \
    dAG+= v;

#define BwdF3r3(addr3,addr2,addr1,dAG,dAH,dBH) \
    v=*(short *)addr3; \
    dAH+= 0; \
    dAG+= 0; \
    dBH-= v; \
    dBH-= v; \
    *(short *)addr1=dAH; \
    *(short *)addr2=dAG; \
    *(short *)addr3=dBH<<1;

#define Bwdr3(base,end,inc) \
    addr0=base; \
    addr3=addr0-(inc>>2); \
    addr2=addr3-(inc>>2); \
    addr1=addr2-(inc>>2); \
    BwdS0r3(addr0,dAG,dAH,dBH); \
```

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```
    addr1+=inc; \
    BwdS1r3(addr1,addr0,dAG,dAH,dBH); \
    addr2+=inc; \
    while(addr2<end) { \
        Bwd2r3(addr2,dAG,dAH,dBG,dBH); \
        addr3+=inc; \
        Bwd3r3(addr3,addr2,addr1,dAG,dAH,dBG,dBH); \
        addr0+=inc; \
        Bwd0r3(addr0,dAG,dAH,dBG,dBH); \
        addr1+=inc; \
        Bwd1r3(addr1,addr0,addr3,dAG,dAH,dBG,dBH); \
        addr2+=inc; \
    } \
    BwdE2r3(addr2,dAG,dAH,dBH); \
    addr3+=inc; \
    BwdE3r3(addr3,addr2,addr1,dAG,dAH,dBH);

extern void FASTBACKWARD(char *data, long inc1, long loop1, long inc2, char *end2)
extern void HAARBACKWARD(char *data, long inc1, long loop1, long inc2, long loop2)
extern void HAARTOPBWD(char *data,long height,long width);
/* extern void  HAARXTOPBWD(char *data,long area);*/

void    FasterBackward(char *data, long inc1, long end1, long inc2, char *end2)
{
    register short  v, vs, v3, dAG, dAH, dBG, dBH, inc;
    register char   *addr0, *addr1, *addr2, *addr3, *end;
    char    *base;

    inc=inc1;
    for(base=data;base<end2;base+=inc2) {
        end=base+end1;
        Bwd(base,end,inc);
    }
}

extern  void    TOPBWD(char *data, char *dst, long size_1, long size_0);

void    TestTopBackward(short *data,int size[2],int oct_src)
{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    for(oct=oct_src-1;oct>0;oct--) {
        long    cinc=2<<oct, cinc4=cinc<<2,
                rinc=size[0]<<oct+1, rinc4=rinc<<2; /* col and row increments in t

        FASTBACKWARD((char *)data,rinc4,area-(rinc<<1),cinc,left);
        FASTBACKWARD((char *)data,cinc4,width-(cinc<<1),rinc,top);
    }
/*  FasterBackward((char *)data,size[0]<<3,area-(size[0]<<2),2,left);
    FasterBackward((char *)data,8,width-4,size[0]<<1,top);*/
    TOPBWD((char *)data,(char *)data,size[0],size[1]);
}
void    TestBackward(data,size,oct_src)

short   *data;
int     size[2], oct_src;

{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;
```

Engineering:KlicsCode:CompPict:Backward.c

```
    for(oct=oct_src-1;oct>=0;oct--) {
        long    cinc=2<<oct, cinc4=cinc<<2,
                rinc=size[0]<<oct+1, rinc4=rinc<<2; /* col and row increments in t

        FasterBackward((char *)data,rinc4,area-(rinc<<1),cinc,left);
        FasterBackward((char *)data,cinc4,width-(cinc<<1),rinc,top);
    }
}

void    Backward3511(data,size,oct_src)

short   *data;
int     size[2], oct_src;

{
    int     oct, area=size[0]*size[1]<<1;
    short   width=size[0]<<1;
    char    *top=area+(char *)data, *left=width+(char *)data;

    for(oct=oct_src-1;oct>0;oct--) {
        long    cinc=2<<oct, cinc4=cinc<<2,
                rinc=size[0]<<oct+1, rinc4=rinc<<2; /* col and row increments in t


        BACK3511((char *)data,rinc4,area-(rinc<<1),cinc,left);
        BACK3511((char *)data,cinc4,width-(cinc<<1),rinc,top);
    }
    BACK3511V((char *)data,size[0]<<3,area-(size[0]<<2),4,left);
    BACK3511H((char *)data,8,width-4,size[0]<<1,top);
/*  TOPBWD((char *)data,(char *)data,size[1],size[0]);*/
}
```

Engineering:KlicsCode:CompPict:Backward.a

```
*---------------------------------
*
*   © Copyright 1993 KLICS Limited
*   All rights reserved.
*
*   Written by: Adrian Lewis
*
*---------------------------------
*
*   680X0 3511 Backward code
*
*   Coeffs 11 19 5 3
*   become  3  5 1 1
*
*---------------------------------
        seg         'klics'
*---------------------------------
        macro
        BwdStart0   &addr0,&dAG,&dAH,&dBH
*
        move.w      (&addr0),&dAH   ; dAH=*(short *)addr0
        move.w      &dAH,&dAG       ; dAG=v
        neg.w       &dAG            ; dAG= -dAG
        move.w      &dAH,&dBH       ; dBH=v
        add.w       &dBH,&dBH       ; dBH=v<<1
*
        endm
*---------------------------------
        macro
        BwdStart1   &addr1,&addr0,&dAG,&dAH,&dBH
*
        move.w      (&addr1),d0     ; v=*(short *)addr1
        move.w      d0,d1           ; v5=v
        asr.w       #1,d1           ; v5=v>>1
        add.w       d1,&dBH         ; dBH+= v>>1
        add.w       d0,&dAG         ; dAG+=v
        sub.w       d0,&dAH         ; dAH-=v
        add.w       d0,d0           ; v<<=1
        add.w       d0,&dAG         ; dAG-=2v
        add.w       d0,d0           ; v<<=1
        sub.w       d0,&dAH         ; dAH-=4v
        asr.w       #1,&dBH         ; dBH>>=1
        move.w      &dBH,(&addr0)   ; *(short *)addr0=dBH
*
        endm
*---------------------------------
        macro
        BwdEven &addr2,&dAG,&dAH,&dBG,&dBH
*
        move.w      (&addr2),d0     ; v=*(short *)addr2
        move.w      d0,&dBH         ; dBH=v
        move.w      d0,&dBG         ; dBG=v
        neg.w       &dBG            ; dBG=-v
        add.w       d0,&dAH         ; dAH+=v
        add.w       d0,&dAG         ; dAG+=v
        add.w       d0,d0           ; 2v
        add.w       d0,&dAH         ; dAH+=v
        add.w       d0,d0           ; 2v
        add.w       d0,&dAG         ; dAH+=v
*
        endm
*---------------------------------
        macro
```

```
                    Engineering:KlicsCode:CompPict:Backward.a
                    ➡
        BwdOdd      &addr3,&addr2,&addr1,&dAG,&dAH,&dBG,&dBH

        move.w      (&addr3),d0     ; v=*(short *)addr3

        add.w       d0,&dAH         ; dAH+=v
        add.w       d0,&dAG         ; dAG+=v
        add.w       d0,&dBG         ; dBG+=v
        sub.w       d0,&dBH         ; dBH-=v
        add.w       d0,d0           ; 2v
        add.w       d0,&dBG         ; dBG+=v
        add.w       d0,d0           ; 4v
        sub.w       d0,&dBH         ; dBH-=4v

        asr.w       #2,&dAH         ; dAH>>=2
        move.w      &dAH,(&addr1)   ; *(short *)addr1=dAH
        asr.w       #2,&dAG         ; dAG>>=2
        move.w      &dAG,(&addr2)   ; *(short *)addr2=dAG

        endm
*-----------------------------------
        macro
        BwdEnd2     &addr2,&dAG,&dAH,&dBH

        move.w      (&addr2),d0     ; v=*(short *)addr2

        add.w       d0,&dAH         ; dAH+=v
        add.w       d0,&dAG         ; dAG+=v
        add.w       d0,d0           ; 2v
        move.w      d0,&dBH         ; dBH=2v
        add.w       d0,&dAH         ; dAH+=2v
        add.w       d0,d0           ; 4v
        add.w       d0,&dAG         ; dAG+=4v

        endm
*-----------------------------------
        macro
        BwdEnd3     &addr3,&addr2,&addr1,&dAG,&dAH,&dBH

        move.w      (&addr3),d0     ; v=*(short *)addr3
        add.w       d0,&dAH         ; dAH+=v
        add.w       d0,&dAG         ; dAG+=v
        lsl.w       #3,d0           ; 8v
        sub.w       d0,&dBH         ; dBH-=8v
        asr.w       #2,&dAH         ; dAH>>=2
        move.w      &dAH,(&addr1)   ; *(short *)addr1=dAH
        asr.w       #2,&dAG         ; dAG>>=2
        move.w      &dAG,(&addr2)   ; *(short *)addr2=dAG
        asr.w       #1,&dBH         ; dBH>>=1
        move.w      &dBH,(&addr3)   ; *(short *)addr3=dBH

        endm
*-----------------------------------
        macro
        Bwd         &base,&end,&inc

        movea.l     &base,a0            ; addr0=base
        move.l      &inc,d0             ; d0=inc
        asr.l       #2,d0               ; d0=inc>>2
        movea.l     a0,a3               ; addr3=addr0
        suba.l      d0,a3               ; addr3-=(inc>>2)
        movea.l     a3,a2               ; addr2=addr3
        suba.l      d0,a2               ; addr2-=(inc>>2)
        movea.l     a2,a1               ; addr1=addr2
```

```
                    Engineering:KlicsCode:CompPict:Backward.a
        suba.l      d0,a1                   ; addr1-=(inc>>2)
        BwdStart0   a0,d4,d5,d7             ; BwdStart0(addr0,dAG,dAH,dBH)
        adda.l      &inc,a1                 ; addr1+=inc
        BwdStart1   a1,a0,d4,d5,d7          ; BwdStart1(addr1,addr0,dAG,dAH,dBH)
        adda.l      &inc,a2                 ; addr2+=inc
@do     BwdEven     a2,d4,d5,d6,d7          ; BwdEven(addr2,dAG,dAH,dBG,dBH)
        adda.l      &inc,a3                 ; addr3+=inc
        BwdOdd      a3,a2,a1,d4,d5,d6,d7    ; BwdOdd(addr3,addr2,addr1,dAG,dAH,dBG
        adda.l      &inc,a0                 ; addr0+=inc
        BwdEven     a0,d6,d7,d4,d5          ; BwdEven(addr0,dBG,dBH,dAG,dAH)
        adda.l      &inc,a1                 ; addr1+=inc
        BwdOdd      a1,a0,a3,d6,d7,d4,d5    ; BwdOdd(addr1,addr0,addr3,dBG,dBH,dAG
        adda.l      &inc,a2                 ; addr2+=inc
        cmpa.l      a2,&end                 ; addr2<end
        bgt.s       @do                     ; while
        BwdEnd2     a2,d4,d5,d7             ; BwdEnd2(addr2,dAG,dAH,dBH)
        adda.l      &inc,a3                 ; addr3+=inc
        BwdEnd3     a3,a2,a1,d4,d5,d7       ; BwdEnd3(addr3,addr2,addr1,dAG,dAH,dB
*
        endm
*---------------------------------
Back3511    FUNC    EXPORT
*
PS      RECORD      0
data    DS.L        1
incl    DS.L        1
end1    DS.L        1
inc2    DS.L        1
end2    DS.L        1
        ENDR
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.incl(a6),d3          ; inc=incl
        movea.l     PS.data(a6),a5          ; base=data
@do     movea.l     a5,a4                   ; end=base
        adda.l      PS.end1(a6),a4          ; end+=end1
        Bwd         a5,a4,d3                ; Bwd(base,end,inc)
        adda.l      PS.inc2(a6),a5          ; base+=inc2
        cmpa.l      PS.end2(a6),a5          ; end2>base
        blt.w       @do                     ; for
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*---------------------------------
        macro
        BwdStartV0  &addr0,&dAG,&dAH,&dBH
*
        move.l      (&addr0),&dAH   ; dAH=*(short *)addr0
        move.l      &dAH,&dAG       ; dAG=v
        neg.l       &dAG            ; dAG= -dAG
        move.l      &dAH,&dBH       ; dBH=v
        add.l       &dBH,&dBH       ; dBH=v<<1
*
        endm
*---------------------------------
        macro
        BwdStartV1  &addr1,&addr0,&dAG,&dAH,&dBH
*
```

=Engineering:KlicsCode:CompPict:Backward.a

```
        move.l      (&addr1),d0     ; v=*(short *)addr1
        move.l      d0,d1           ; vs=v
        asr.l       #1,d1           ; vs=v>>1
        add.l       d1,&dBH         ; dBH+= v>>1
        add.l       d0,&dAG         ; dAG+=v
        sub.l       d0,&dAH         ; dAH-=v
        add.l       d0,d0           ; v<<=1
        add.l       d0,&dAG         ; dAG+=2v
        add.l       d0,d0           ; v<<=1
        sub.l       d0,&dAH         ; dAH-=4v

        asr.l       #1,&dBH         ; dBH>>=1
        add.w       &dBH,&dBH       ; shift word back
        asr.w       #1,&dBH         ; dBH>>=1
        move.l      &dBH,(&addr0)   ; *(short *)addr0=dBH

        endm
;---------------------------------
        macro
BwdEvenV    &addr2,&dAG,&dAH,&dBG,&dBH

        move.l      (&addr2),d0     ; v=*(short *)addr2
        move.l      d0,&dBH         ; dBH=v
        move.l      d0,&dBG         ; dBG=v
        neg.l       &dBG            ; dBG=-v
        add.l       d0,&dAH         ; dAH+=v
        add.l       d0,&dAG         ; dAG+=v
        add.l       d0,d0           ; 2v
        add.l       d0,&dAH         ; dAH+=v
        add.l       d0,d0           ; 2v
        add.l       d0,&dAG         ; dAH+=v

        endm
;---------------------------------
        macro
BwdOddV     &addr3,&addr2,&addr1,&dAG,&dAH,&dBG,&dBH

        move.l      (&addr3),d0     ; v=*(short *)addr3

        add.l       d0,&dAH         ; dAH+=v
        add.l       d0,&dAG         ; dAG+=v
        add.l       d0,&dBG         ; dBG+=v
        sub.l       d0,&dBH         ; dBH-=v
        add.l       d0,d0           ; 2v
        add.l       d0,&dBG         ; dBG+=v
        add.l       d0,d0           ; 4v
        sub.l       d0,&dBH         ; dBH-=4v

        asr.l       #2,&dAH         ; dAH>>=2
        lsl.w       #2,&dAH         ; shift word back
        asr.w       #2,&dAH         ; dAH>>=2
        move.l      &dAH,(&addr1)   ; *(short *)addr1=dAH
        asr.l       #2,&dAG         ; dAG>>=2
        lsl.w       #2,&dAG         ; shift word back
        asr.w       #2,&dAG         ; dAG>>=2
        move.l      &dAG,(&addr2)   ; *(short *)addr2=dAG

        endm
;---------------------------------
        macro
BwdEndV2    &addr2,&dAG,&dAH,&dBH

        move.l      (&addr2),d0     ; v=*(short *)addr2
```

Engineering:KlicsCode:CompPict:Backward.a

```
        add.l       d0,&dAH          ; dAH+=v
        add.l       d0,&dAG          ; dAG+=v
        add.l       d0,d0            ; 2v
        move.l      d0,&dBH          ; dBH=2v
        add.l       d0,&dAH          ; dAH+=2v
        add.l       d0,d0            ; 4v
        add.l       d0,&dAG          ; dAG+=4v
*
        endm
*-----------------------------------
        macro
        BwdEndV3    &addr3,&addr2,&addr1,&dAG,&dAH,&dBH
*
        move.l      (&addr3),d0      ; v=*(short *)addr3
        add.l       d0,&dAH          ; dAH+=v
        add.l       d0,&dAG          ; dAG+=v
        lsl.l       #3,d0            ; 8v
        sub.l       d0,&dBH          ; dBH-=8v
        asr.l       #2,&dAH          ; dAH>>=2
        lsl.w       #2,&dAH          ; shift word back
        asr.w       #2,&dAH          ; dAH>>=2
        move.l      &dAH,(&addr1)    ; *(short *)addr1=dAH
        asr.l       #2,&dAG          ; dAG>>=2
        lsl.w       #2,&dAG          ; shift word back
        asr.w       #2,&dAG          ; dAG>>=2
        move.l      &dAG,(&addr2)    ; *(short *)addr2=dAG
        asr.l       #1,&dBH          ; dBH>>=1
        lsl.w       #1,&dBH          ; shift word back
        asr.w       #1,&dBH          ; dAH>>=2
*       add.l       &dBH,&dBH        ; dBH<<=1
        move.l      &dBH,(&addr3)    ; *(short *)addr3=dBH
*
        endm
*-----------------------------------
        macro
        BwdV        &base,&end,&inc
*
        movea.l     &base,a0                ; addr0=base
        move.l      &inc,d0                 ; d0=inc
        asr.l       #2,d0                   ; d0=inc>>2
        movea.l     a0,a3                   ; addr3=addr0
        suba.l      d0,a3                   ; addr3-=(inc>>2)
        movea.l     a3,a2                   ; addr2=addr3
        suba.l      d0,a2                   ; addr2-=(inc>>2)
        movea.l     a2,a1                   ; addr1=addr2
        suba.l      d0,a1                   ; addr1-=(inc>>2)
        BwdStartV0  a0,d4,d5,d7             ; BwdStart0(addr0,dAG,dAH,dBH)
        adda.l      &inc,a1                 ; addr1+=inc
        BwdStartV1  a1,a0,d4,d5,d7          ; BwdStart1(addr1,addr0,dAG,dAH,dBH)
        adda.l      &inc,a2                 ; addr2+=inc
@do     BwdEvenV    a2,d4,d5,d6,d7          ; BwdEven(addr2,dAG,dAH,dBG,dBH)
        adda.l      &inc,a3                 ; addr3+=inc
        BwdOddV     a3,a2,a1,d4,d5,d6,d7    ; BwdOdd(addr3,addr2,addr1,dAG,dAH,dBG
        adda.l      &inc,a0                 ; addr0+=inc
        BwdEvenV    a0,d6,d7,d4,d5          ; BwdEven(addr0,dBG,dBH,dAG,dAH)
        adda.l      &inc,a1                 ; addr1+=inc
        BwdOddV     a1,a0,a3,d6,d7,d4,d5    ; BwdOdd(addr1,addr0,addr3,dBG,dBH,dAG
        adda.l      &inc,a2                 ; addr2+=inc
        cmpa.l      a2,&end                 ; addr2<end
        bgt.s       @do                     ; while
        BwdEndV2    a2,d4,d5,d7             ; BwdEnd2(addr2,dAG,dAH,dBH)
        adda.l      &inc,a3                 ; addr3-=inc
```

```
                    Engineering:KlicsCode:CompPict:Backward.a

        BwdEndV3    a3,a2,a1,d4,d5,d7       ; BwdEnd3(addr3,addr2,addr1,dAG,dAH,dB
*
        endm
*-----------------------------------
Back3511V   FUNC    EXPORT
*
PS      RECORD      0
data    DS.L        1
incl    DS.L        1
endl    DS.L        1
inc2    DS.L        1
end2    DS.L        1
        ENDR
*
        link        a6,#0                   ; no local variables
        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.incl(a6),d3          ; inc=incl
        movea.l     PS.data(a6),a5          ; base=data
@do     movea.l     a5,a4                   ; end=base
        adda.l      PS.endl(a6),a4          ; end+=endl
        BwdV        a5,a4,d3                ; Bwd(base,end,inc)
        adda.l      PS.inc2(a6),a5          ; base+=inc2
        cmpa.l      PS.end2(a6),a5          ; end2>base
        blt.w       @do                     ; for
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-----------------------------------
        macro
        BwdStartH   &addrR,&A,&C
*
        move.l      (&addrR)+,&A    ; 1H1G=*(long *)addrR
        move.l      &A,d0           ; A=1H1G, d0=1H1G
        move.l      &A,&C           ; A=1H1G, d0=1H1G, C=1H1G
        add.w       &A,d0           ; A=1H1G, d0=1H2G, C=1H1G
        add.w       d0,&A           ; A=1H3G, d0=1H2G, C=1H1G
        add.w       &A,d0           ; A=1H3G, d0=1H5G, C=1H1G
        swap        &A              ; A=3GH1, d0=1H5G, C=1H1G
        sub.l       d0,&A           ; A=AAAA, d0=1H5G, C=1H1G
*
        endm
*-----------------------------------
        macro
        BwdCycleH   &addrR,&addrW,&A,&B,&C
*
        move.l      (&addrR)+,&B    ; 1H1G=*(long *)addrR
        move.l      &B,d0           ; B=1H1G, d0=1H1G
        add.l       d0,d0           ; B=1H1G, d0=2H2G
        move.l      d0,d1           ; B=1H1G, d0=2H2G, d1=2H2G
        add.l       &B,d0           ; B=1H1G, d0=3H3G, d1=2H2G
        add.l       d0,d1           ; B=1H1G, d0=3H3G, d1=5H5G
        move.l      &B,d2           ; B=1H1G, d0=3H3G, d1=5H5G, d2=1H1G
        move.w      d1,d2           ; B=1H1G, d0=3H3G, d1=5H5G, d2=1H5G
        move.w      &B,d1           ; B=1H1G, d0=3H3G, d1=5H1G, d2=1H5G
        move.w      d0,&B           ; B=1H3G, d0=3H3G, d1=5H1G, d2=1H5G
        move.w      d1,d0           ; B=1H3G, d0=3H1G, d1=5H1G, d2=1H5G
        swap        &B              ; B=3G1H, d0=3H1G, d1=5H1G, d2=1H5G
        swap        d0              ; B=3G1H, d0=1G3H, d1=5H1G, d2=1H5G
```

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```
        sub.l       d2,&B           ; B=3G1H-1H5G
        add.l       d0,&A           ; A+=1H3G
        add.l       d1,&A           ; A+=5G1H

        asr.w       #2,&A           ; A0>>=2
        move.w      &A,&C           ; C complete
        asr.l       #2,&A           ; A1>>=2
        move.l      &C,(&addrW)+    ; *(long *)addrW=DD
        move.l      &A,&C           ; C=A1XX
*
        endm
*-----------------------------------
        macro
        BwdEndH     &addrR,&addrW,&A,&B,&C
*
        move.l      (&addrR)+,d0    ; 1H1G=*(long *)addrR
        move.w      d0,d2           ; d2=1G
        lsl.w       #2,d2           ; d2=4G
        neg.w       d2              ; d2=-4G
        swap        d0              ; d0=1G1H
        add.w       d0,d2           ; d2=-1H
        move.l      d0,d1           ; d0=1G1H, d1=1G1H
        add.w       d0,d1           ; d0=1G1H, d1=1G2H
        add.w       d1,d0           ; d0=1G3H, d1=1G2H
        add.w       d0,d1           ; d0=1G3H, d1=1G5H
        swap        d1              ; d0=1G3H, d1=5H1G
        add.l       d0,&A           ; A+=1G3H
        add.l       d1,&A           ; A+=5H1G

        asr.w       #2,&A           ; A1>>=2
        move.w      &A,&C           ; C complete
        asr.l       #2,&A           ; A0>>=2
        move.l      &C,(&addrW)+    ; *(long *)addrW=C
        move.w      d2,&A           ; A=D1D2
        move.l      &A,(&addrW)+    ; *(long *)addrW=A
*
        endm
*-----------------------------------
        macro
        BwdH        &base,&end,&inc
*
        movea.l     &base,a0                ; addrR=base
        movea.l     a0,a1                   ; addrW=addrR
        BwdStartH   a0,d3,d5                ; BwdStart(addrR,A,DD)
.do     BwdCycleH   a0,a1,d3,d4,d5          ; BwdCycle(addrR,addrW,A,B,C)
        BwdCycleH   a0,a1,d4,d3,d5          ; BwdCycle(addrR,addrW,B,A,C)
        cmpa.l      a0,&end                 ; addr2<end
        bgt.s       @do                     ; while
        BwdEndH     a0,a1,d3,d4,d5          ; BwdEnd(addrR,addrW,A,B,DD)
*
        endm
*-----------------------------------
Back3511H   FUNC    EXPORT
*
PS      RECORD      8
data    DS.L        1
inc1    DS.L        1
end1    DS.L        1
inc2    DS.L        1
end2    DS.L        1
        ENDR
*
        link        a6,a0                   ; no local variables
```

```
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        movem.l     d4-d7/a3-a5,-(a7)       ; store registers
*
        move.l      PS.inc1(a6),d3          ; inc=inc1
        movea.l     PS.data(a6),a5          ; base=data
@do     movea.l     a5,a4                   ; end=base
        adda.l      PS.end1(a6),a4          ; end+=end1
        BwdH        a5,a4,d3                ; Bwd(base,end,inc)
        adda.l      PS.inc2(a6),a5          ; base+=inc2
        cmpa.l      PS.end2(a6),a5          ; end2>base
        blt.w       @do                     ; for
*
        movem.l     (a7)+,d4-d7/a3-a5       ; restore registers
        unlk        a6                      ; remove locals
        rts                                 ; return
*
        ENDFUNC
*-----------------------------------
        END
```

Engineering:KlicsCode:CompPict:KlicsEnc.c

```
/*.....................................
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 .....................................*/
/*
 *  Full still/video Knowles-Lewis Image KlicsEncode System utilising HVS properti
 *  and delta-tree coding
 *
 *  Recoded and re-rationalised (Stand alone version)
 */

#include    <FixMath.h>
#include    "Bits3.h"
#include    "Klics.h"
#include    "KlicsHeader.h"
#include    "KlicsEncode.h"


#include    <Math.h>

/* If bool true the negate value */
#define negif(bool,value)   ((bool)?-(value):(value))
#define abs(value)          negif(value<0,value)

extern  void    HaarForward();
extern  void    Daub4Forward();

/* Use the bit level file macros (Bits2.h)
buf_use;*/

/* Huffman encode a block */
#define HuffEncLev(lev,buf) \
    HuffEncode(lev[0],buf); \
    HuffEncode(lev[1],buf); \
    HuffEncode(lev[2],buf); \
    HuffEncode(lev[3],buf);

/* Fixed length encode block of integers */
#define IntEncLev(lev,lpf_bits,buf) \
    IntEncode(lev[0],lpf_bits,buf); \
    IntEncode(lev[1],lpf_bits,buf); \
    IntEncode(lev[2],lpf_bits,buf); \
    IntEncode(lev[3],lpf_bits,buf);

/* Define write a zero */
#define Token0 \
    buf_winc(buf);

/* Define write a one */
#define Token1 \
    buf_set(buf); buf_winc(buf);

/* Write block for data and update memory */
#define DoXfer(addr,pro,lev,dst,mode,oct,nmode,buf) \
    HuffEncLev(lev,buf); \
    PutData(addr,pro,dst); \
    mode[oct]=oct==0?M_STOP:nmode;

/*  Function Name:  Quantize
```

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```
 *  Description:    H.261 style quantizer
 *  Arguments:  new, old - image blocks
 *              pro, lev - returned values
 *              q - quantizing divisor
 *  Returns:    lev is all zero, quantized data (pro) & level (lev)
 */

Boolean Quantize(int new[4], int old[4], int pro[4], int lev[4], short q)
{
    int     blk, half_q=(1<<q)-1>>1;

    for(blk=0;blk<4;blk++) {
        int     data=new[blk]-old[blk],
                mag_level=abs(data)>>q;

        mag_level=mag_level>135?135:mag_level;
        lev[blk]=negif(data<0,mag_level);
        pro[blk]=old[blk]+negif(data<0,(mag_level<<q)+(mag_level!=0?half_q:0));
    }
    return(pro[0]==0 && pro[1]==0 && pro[2]==0 && pro[3]==0);
}

void    QuantizeLPF(int new[4],int pro[4],int lev[4],short q)
{
    int     blk, half_q=(1<<q)-1>>1;

    for(blk=0;blk<4;blk++) {
        int     data=new[blk],
                mag_level=abs(data)>>q;

        lev[blk]=negif(data<0,mag_level);
        pro[blk]=(lev[blk]<<q)+half_q;
    }
}

/*  Function Name:  GuessQuantize
 *  Description:    Estimate threshold quantiser value
 *  Arguments:  new, old - image blocks
 *              q - q weighting factor
 *  Returns:    estimated q_const
 */

float   GuessQuantize(int new[4],int old[4],float q)
{
    int     blk;
    float   qt_max=0.0;

    for(blk=0;blk<4;blk++) {
        int     i, data=abs(new[blk]-old[blk]);
        float   qt;

        for(i=0;data!=0;i++) data>>=1;
        if (i>0) i--;
        qt=(((3<<i)-1)>>1)/q;

        qt_max=qt_max>qt?qt_max:qt;
    }
    return(qt_max);
}

/*  Function Name:  IntEncode
 *  Description:    Write a integer to bit file
 *  Arguments:  lev - integer to write now signed
```

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```
 *              bits - no of bits
 */

void    IntEncode(int lev,int bits,Buf buf)
{
/* Old version
    int     i;

    for(i=bits-1;i>=0;i--) {
        if (lev&(1<<i)) buf_set(buf);
        buf_winc(buf);
    }
*/
/* New version
    int     i, mag=abs(lev);
    Boolean sign=lev<0;

    if (1<<bits-1 <= mag) mag=(1<<bits-1)-1;
    if (sign) buf_set(buf);
    buf_winc(buf);
    for(i=1<<bits-2;i!=0;i>>=1) {
        if (mag&i) buf_set(buf);
        buf_winc(buf);
    }*/
/* Hardware compatable version: sign mag(lsb->msb) */
    int     i, mag=abs(lev);
    Boolean sign=lev<0;

    if (1<<bits-1 <= mag) mag=(1<<bits-1)-1;
    if (sign) buf_set(buf);
    buf_winc(buf);
    for(i=1;i!=1<<bits-1;i<<=1) {
        if (mag&i) buf_set(buf);
        buf_winc(buf);
    }
}

/*  Function Name:  HuffEncodeSA
 *  Description:    Write a Huffman coded integer to bit file
 *  Arguments:  lev - integer value
 *  Returns:    no of bits used
 */

void    HuffEncode(int lev,Buf buf)
{
/*  int     level=abs(lev);

    if (level>1) buf_set(buf);
    buf_winc(buf);
    if(level>2 || level==1) buf_set(buf);
    buf_winc(buf);
    if (level!=0) {
        if (lev<0) buf_set(buf);
        buf_winc(buf);
        if (level>2) {
            int     i;

            for(i=3;i<level;i++) {
                buf_winc(buf);
            }
            buf_set(buf);
            buf_winc(buf);
        }
```

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```
    )*/

/* New version */
    int     level=abs(lev), i;

    if (level!=0) buf_set(buf);
    buf_winc(buf);
    if (level!=0) {
        if (lev<0) buf_set(buf);
        buf_winc(buf);
        if (level<8) {
            while (1<level--)
                buf_winc(buf);
            buf_set(buf);
            buf_winc(buf);
        } else {
            for(i=0;i<7;i++)
                buf_winc(buf);
            level-=8;
            for(i=1<<6;i!=0;i>>=1) {
                if (level&i) buf_set(buf);
                buf_winc(buf);
            }
        }
    }
}

/*  Function Name:  KlicsECbannel
 *  Description:    Encode a channel of image
 *  Arguments:  src - source channel memory
 *              dst - destination memory (and old for videos)
 *              octs, size - octaves of decomposition and image dimensions
 *              normals - HVS weighted normals
 *              lpf_bits - no of bits for LPF integer (image coding only)
 */

void    KlicsEncY(short *src,short *dst,int octs,int size[2],int thresh[5], int co
{
    int     oct, mask, x, y, sub, tmp, step=2<<octs, blk[4], mode[4], nz, no, base
    int     addr[4], new[4], old[4], pro[4], lev[4], zero[4]={0,0,0,0};
    Boolean nzflag, noflag, origin;
    int     bitmask=-1<<kle->seqh.precision-kle->frmh.quantizer[0]-1;
    Buf     buf=&kle->buf;

    for(y=0;y<size[1];y+=step)
    for(x=0;x<size[0];x+=step)
    for(sub=0;sub<4;sub++) {
    mode[oct=octs-1]=base_mode;
    if (sub==0) mode[oct=octs-1] |= M_LPF;
    mask=2<<oct;
    do {
        GetAddr(addr,x,y,sub,oct,size,mask);
        switch(mode[oct]) {
        case M_VOID:
            GetData(addr,old,dst);
            if (BlkZero(old)) mode[oct]=M_STOP;
            else { DoZero(addr,dst,mode,oct); }
            break;
        case M_SEND|M_STILL:
            GetData(addr,new,src);
            nz=Decide(new); nzflag=nz<=thresh[octs-oct];
            if (nzflag || Quantize(new,zero,pro,lev,kle->frmh.quantizer[octs-oct])
                GetData(addr,old,dst);
```

```
=Engineering:KlicsCode:CompPict:KlicsEnc.c

        if (BlkZero(old)) {
            Token0;
            mode[oct]=M_STOP;
        } else {
            Token1; Token1;
            DoZero(addr,dst,mode,oct);
        }
    } else {
        Token1; Token0;
        DoXfer(addr,pro,lev,dst,mode,oct,M_SEND|M_STILL,buf);
    }
    break;
case M_SEND:
    GetData(addr,new,src);
    GetData(addr,old,dst);
    nz=Decide(new); nzflag=nz<=thresh[octs-oct];
    if (BlkZero(old)) {
        if (nzflag || Quantize(new,zero,pro,lev,kle->frmh.quantizer[octs-o
            Token0;
            mode[oct]=M_STOP;
        } else {
            Token1; Token0;
            DoXfer(addr,pro,lev,dst,mode,oct,M_SEND|M_STILL,buf);
        }
    } else {
        int     oz=Decide(old), no=DecideDelta(new,old);
        Boolean motion=(nz+oz)>>oct <= no; /* motion detection */

        no=DecideDelta(new,old); noflag=no<=compare[octs-oct];
        origin=nz<=no;
            if ((!noflag || motion)  && !nzflag) { /* was !noflag && !nzfl
            if (Quantize(new,origin?zero:old,pro,lev,kle->frmh.quantizer[o
                Token1; Token1; Token0;
                DoZero(addr,dst,mode,oct);
            } else {
                if (origin) {
                    Token1; Token0;
                    DoXfer(addr,pro,lev,dst,mode,oct,M_SEND|M_STILL,buf);
                } else {
                    Token1; Token1; Token1;
                    DoXfer(addr,pro,lev,dst,mode,oct,M_SEND,buf);
                }
            }
        } else {
                if ((motion || origin) && nzflag) { /* was origin && nzfla
                Token1; Token1; Token0;
                DoZero(addr,dst,mode,oct);
            } else {
                Token0;
                mode[oct]=M_STOP;
            }
        }
    }
    break;
case M_STILL:
    GetData(addr,new,src);
    nz=Decide(new); nzflag=nz<=thresh[octs-oct];
    if (nzflag || Quantize(new,zero,pro,lev,kle->frmh.quantizer[octs-oct])
        Token0;
        mode[oct]=M_STOP;
    } else {
        Token1;
        DoXfer(addr,pro,lev,dst,mode,oct,M_STILL,buf);
```

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```
            }
            break;
        case M_LPF|M_STILL:
            GetData(addr,new,src);
            QuantizeLPF(new,pro,lev,kle->frmh.quantizer[0]);
            VerifyData(lev[0],bitmask,tmp);
            VerifyData(lev[1],bitmask,tmp);
            VerifyData(lev[2],bitmask,tmp);
            VerifyData(lev[3],bitmask,tmp);
            IntEncLev(lev,kle->seqh.precision-kle->frmh.quantizer[0],buf);
            PutData(addr,pro,dst);
            mode[oct]=M_QUIT;
            break;
        case M_LPF|M_SEND:
            GetData(addr,new,src);
            GetData(addr,old,dst);
            no=DecideDelta(new,old); noflag=no<=compare[octs-oct];
            if (noflag) {
                Token0;
            } else {
                Token1;
                Quantize(new,old,pro,lev,kle->frmh.quantizer[0]);
                HuffEncLev(lev,buf);
                PutData(addr,pro,dst);
            }
            mode[oct]=M_QUIT;
            break;
        }
        switch(mode[oct]) {
        case M_STOP:
            StopCounters(mode,oct,mask,blk,x,y,octs);
            break;
        case M_QUIT:
            break;
        default:
            DownCounters(mode,oct,mask,blk);
            break;
        }
    } while (mode[oct]!=M_QUIT);
    }
}

void    KlicsEncUV(short *src,short *dst,int octs,int size[2],int thresh[5], int c
{
    int     oct, mask, x, y, X, Y, sub, tmp, step=4<<octs, blk[4], mode[4], nz, no
    int     addr[4], new[4], old[4], pro[4], lev[4], zero[4]={0,0,0,0};
    Boolean nzflag, noflag, origin;
    int     bitmask=-1<<kle->seqh.precision-kle->frmh.quantizer[0]-1;
    Buf     buf=&kle->buf;

    for(Y=0;Y<size[1];Y+=step)
    for(X=0;X<size[0];X+=step;
    for(y=Y;y<size[1] && y<Y+step;y+=step>>1)
    for(x=X;x<size[0] && x<X+step;x+=step>>1)
    for(sub=0;sub<4;sub++) {
    mode[oct=octs-1]=base_mode;
    if (sub==0) mode[oct=octs-1] |= M_LPF;
    mask=2<<oct;
    do {
        GetAddr(addr,x,y,sub,oct,size,mask);
        switch(mode[oct]) {
        case M_VOID:
            GetData(addr,old,dst);
```

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```
    if (BlkZero(old)) mode[oct]=M_STOP;
    else { DoZero(addr,dst,mode,oct); }
    break;
case M_SEND|M_STILL:
    GetData(addr,new,src);
    nz=Decide(new); nzflag=nz<=thresh[octs-oct];
    if (nzflag || Quantize(new,zero,pro,lev,kle->frmh.quantizer[octs-oct])
        GetData(addr,old,dst);
        if (BlkZero(old)) {
            Token0;
            mode[oct]=M_STOP;
        } else {
            Token1; Token1;
            DoZero(addr,dst,mode,oct);
        }
    } else {
        Token1; Token0;
        DoXfer(addr,pro,lev,dst,mode,oct,M_SEND|M_STILL,buf);
    }
    break;
case M_SEND:
    GetData(addr,new,src);
    GetData(addr,old,dst);
    nz=Decide(new); nzflag=nz<=thresh[octs-oct];
    if (BlkZero(old)) {
        if (nzflag || Quantize(new,zero,pro,lev,kle->frmh.quantizer[octs-o
            Token0;
            mode[oct]=M_STOP;
        } else {
            Token1; Token0;
            DoXfer(addr,pro,lev,dst,mode,oct,M_SEND|M_STILL,buf);
        }
    } else {
        int     oz=Decide(old), no=DecideDelta(new,old);
        Boolean motion=(nz+oz)>>oct <= no; /* motion detection */

        no=DecideDelta(new,old); noflag=no<=compare[octs-oct];
        origin=nz<=no;
            if ((!noflag || motion)  && !nzflag) { /* was !noflag && !nzfl
            if (Quantize(new,origin?zero:old,pro,lev,kle->frmh.quantizer[o
                Token1; Token1; Token0;
                DoZero(addr,dst,mode,oct);
            } else {
                if (origin) {
                    Token1; Token0;
                    DoXfer(addr,pro,lev,dst,mode,oct,M_SEND|M_STILL,buf);
                } else {
                    Token1; Token1; Token1;
                    DoXfer(addr,pro,lev,dst,mode,oct,M_SEND,buf);
                }
            }
        } else {
                if ((motion || origin) && nzflag) { /* was origin && nzfla
                Token1; Token1; Token0;
                DoZero(addr,dst,mode,oct);
            } else {
                Token0;
                mode[oct]=M_STOP;
            }
        }
    }
    break;
case M_STILL:
```

Engineering:KlicsCode:CompPict:KlicsEnc.c

```
            GetData(addr,new,src);
            nz=Decide(new); nzflag=nz<=thresh[octs-oct];
            if (nzflag || Quantize(new,zero,pro,lev,kle->frmh.quantizer[octs-oct]);
                Token0;
                mode[oct]=M_STOP;
            } else {
                Token1;
                DoXfer(addr,pro,lev,dst,mode,oct,M_STILL,buf);
            }
            break;
        case M_LPF|M_STILL:
            GetData(addr,new,src);
            QuantizeLPF(new,pro,lev,kle->frmh.quantizer[0]);
            VerifyData(lev[0],bitmask,tmp);
            VerifyData(lev[1],bitmask,tmp);
            VerifyData(lev[2],bitmask,tmp);
            VerifyData(lev[3],bitmask,tmp);
            IntEncLev(lev,kle->seqh.precision-kle->frmh.quantizer[0],buf);
            PutData(addr,pro,dst);
            mode[oct]=M_QUIT;
            break;
        case M_LPF|M_SEND:
            GetData(addr,new,src);
            GetData(addr,old,dst);
            no=DecideDelta(new,old); noflag=no<=compare[octs-oct];
            if (noflag) {
                Token0;
            } else {
                Token1;
                Quantize(new,old,pro,lev,kle->frmh.quantizer[0]);
                HuffEncLev(lev,buf);
                PutData(addr,pro,dst);
            }
            mode[oct]=M_QUIT;
            break;
        }
        switch(mode[oct]) {
        case M_STOP:
            StopCounters(mode,oct,mask,blk,x,y,octs);
            break;
        case M_QUIT:
            break;
        default:
            DownCounters(mode,oct,mask,blk);
            break;
        }
    } while (mode[oct]!=M_QUIT);
    }
}

/* index to quant and vice versa */
#define i2q(i)  (float)i*HISTO_DELTA/(float)HISTO
#define q2i(q)  Fix2Long(X2Fix(q*(float)HISTO/HISTO_DELTA))


/*  Function Name:  LookAhead
 *  Description:    Examine base of tree to calculate new quantizer value
 *  Arguments:  src - source channel memory
 *              dst - destination memory (and old for videos)
 *              octs, size - octaves of decomposition and image dimensions
 *              norms - base HVS weighted normals
 *  Returns:    calculates new quant
 */
```

```
= Engineering:KlicsCode:CompPict:KlicsEnc.c

void    LookAhead(short *src,short *dst,float norms[3][3],KlicsE kle)
{
    int     x, y, sub, index, size[2]={kle->seqh.sequence_size[0],kle->seqh.sequen
            thresh[HISTO], quact[HISTO], target;
    int     new[4], old[4], addr[4], zero[4]={0,0,0,0};
    float   quant;

    for(index=0;index<HISTO;index++) {
        thresh[index]=0;
        quact[index]=0;
    }
    for(y=0;y<size[1];y+=2<<octs)
    for(x=0;x<size[0];x+=2<<octs)
    for(sub=1;sub<4;sub++) {
        float   q_thresh;
        int     nz, no, oz, blk;
        Boolean ozflag, origin, motion;

        GetAddr(addr,x,y,sub,octs-1,size,1<<octs);
        GetData(addr,new,src);
        GetData(addr,old,dst);
        nz=Decide(new);
        oz=Decide(old);
        no=DecideDelta(new,old);
        ozflag=kle->encd.intra || BlkZero(old);
        origin=nz<=no;
        motion=(nz+oz)>>octs <= no;
        q_thresh=(float)nz/DecideDouble(norms[1][1]);
        if (ozflag || origin) {
            float   qt=GuessQuantize(new,zero,norms[1][0]);

            q_thresh=q_thresh<qt?q_thresh:qt;
        } else {
            float  qt=GuessQuantize(new,old,norms[1][0]);

            q_thresh=q_thresh<qt?q_thresh:qt;
            if (!motion) {
                qt=(float)no/DecideDouble(norms[1][2]);
                q_thresh=q_thresh<qt?q_thresh:qt;
            }
        }
        index=q2i(q_thresh);
        index=index<0?0:index>HISTO-1?HISTO-1:index;
        thresh[index]++;
    }
    for(index=HISTO-1;index>=0;index--)
        quact[index]=thresh[index]*index+(index==HISTO-1?0:quact[index+1]);

    /* buffer must be greater than bfp_in after this frame */
    /* buffer must be less than buff_size-bfp_in */
    target=kle->encd.bpf_out*kle->encd.prevquact/kle->encd.prevbytes; /* previous
    index=1;
    while(index<HISTO && quact[index]/index>target) index++;
    quant=i2q(index);

    kle->encd.tmp_quant=(kle->encd.tmp_quant+quant)/2.0;
    kle->encd.tmp_quant=i2q((index=q2i(kle->encd.tmp_quant))); /* forward and reve

    kle->encd.prevquact=quact[index]/(index==0?1:index);
}

/*  Function Name:  BaseNormals
```

Engineering:KlicsCode:CompPict:KlicsEnc.c

```
 *  Description:    Calculates base HVS weighted normals
 *  Arguments:  norms - storage for normals
 *  Returns:    weighted normals
 */

void    BaseNormals(float norms[5][3],KlicsE kle)
{
    float   base_norm[3]={1.0,kle->encd.thresh,kle->encd.compare};
    int     norm, oct;

    for(oct=0;oct<5;oct++)
        for(norm=0;norm<3;norm++)
                norms[oct][norm]=base_norm[norm]*kle->encd.base[oct]*(float)(1<<kl
}

/*  Function Name:  Normals
 *  Description:    Calculates HVS weighted normals @ quant
 *  Arguments:  norms - storage for normals
 *  Returns:    weighted normals and LPF bits
 */

void    Normals(float base_norms[5][3],int thresh[5],int compare[5],KlicsE kle)
{

    int     oct, i, norm;

    for(oct=0;oct<=kle->seqh.octaves[0];oct++) {
        norm=Fix2Long(X2Fix(base_norms[oct][0]*kle->encd.tmp_quant));
        norm=norm<171:norm;
        for(i=0;0!=(norm&-3);i++)
                norm=norm>>1;
        switch(norm) {
        case 1:
            kle->frmh.quantizer[oct]=i;
            break;
        case 2:
            kle->frmh.quantizer[oct]=i+1;
            break;
        case 3:
        case 4:
            kle->frmh.quantizer[oct]=i+2;
        }
        thresh[oct]=Fix2Long(X2Fix(DecideDouble(base_norms[oct][1]*kle->encd.tmp_Q
        compare[oct]=Fix2Long(X2Fix(DecideDouble(base_norms[oct][2]*kle->encd.tmp_
    }
    kle->frmh.quantizer[0]=kle->frmh.quantizer[0]<3?3:kle->frmh.quantizer[0];
    /* minimum 4 bits of quant for lpf due to dynamic range problems */
}

Boolean KlicsFlags(KlicsE kle)
{
    Boolean skip=false;

    kle->encd.buffer-=kle->encd.bpf_in;
    kle->frmh.flags=0;
    if (kle->encd.buffer<0)
        kle->encd.buffer=0;
    if (kle->encd.intra)
        kle->frmh.flags |= KFH_INTRA;
    else
        if (skip=kle->encd.buf_sw && kle->encd.buffer>=kle->encd.buf_size)
            kle->frmh.flags |= KFH_SKIP;
    return(skip);
```

Engineering:KlicsCode:CompPict:KlicsEnc.c

```
/*
 * Function Name:  KlicsEncode
 * Description:    Encode a frame from YUV (de)transformed image
 * Arguments:  src - source image(s)
 *             dst - transformed destination memory (and old for videos)
 */

long    KlicsEncode(short *src[3], short *dst[3], KlicsE kle)
{
    float   base_norms[5][3];
    int     channel, thresh[5], compare[5];
    Buf     buf=&kle->buf;

    buf_winit(buf)
    if (KlicsFlags(kle))
        kle->frmh.length=0;
    else {
        for(channel=0;channel<kle->seqh.channels;channel++) {
            int     size[2]={(kle->seqh.sequence_size[0]>>(channel==0?0:kle->seqh.s
                             kle->seqh.sequence_size[1]>>(channel==0?0:kle->seqh.su
                    area=size[0]*size[1], octs=kle->seqh.octaves[channel==0?0:

            switch(kle->seqh.wavelet) {
            case WT_Haar:
                HaarForward(src[channel],size,octs);
                break;
            case WT_Daub4:
                Daub4Forward(src[channel],size,octs);
                break;
            }
        }
        BaseNormals(base_norms,kle);
        if (kle->encd.auto_q && !kle->encd.intra)
            LookAhead(src[0],dst[0],base_norms,kle);
        else
            kle->encd.tmp_quant=kle->encd.quant;
        Normals(base_norms,thresh,compare,kle);
        for(channel=0;channel<kle->seqh.channels;channel++) {
            int     size[2]={(kle->seqh.sequence_size[0]>>(channel==0?0:kle->seqh.s
                             kle->seqh.sequence_size[1]>>(channel==0?0:kle->seqh.sub_sa
                    octs=kle->seqh.octaves[channel==0?0:1];

            if (kle->encd.intra)
                KLZERO(dst[channel],size[0]*size[1]);
            if (channel==0) KlicsEncY(src[channel],dst[channel],octs,size,thresh,c
            else KlicsEncUV(src[channel],dst[channel],octs,size,thresh,compare,kle
        }
        buf_flush(buf);
        kle->frmh.length=buf_size(buf);
        kle->encd.buffer+=kle->frmh.length;
        if (!kle->encd.intra)
            kle->encd.prevbytes=kle->frmh.length;
    }
    return(kle->frmh.length);
}
```

Engineering:KlicsCode:CompPict:KlicsHeader.h

```
/*********************************
 *
 *  © Copyright 1993 KLICS Limited
 *  All rights reserved.
 *
 *  Written by: Adrian Lewis
 *
 *********************************/
/*
 *  Sequence and frame headers for Klics-Encoded files
 *  High byte first
 */

typedef struct {
    unsigned short  description_length; /* Fixed    - Size of this or parent struc
    unsigned char   version_number[2];  /* Fixed    - Version and revision numbers
} KlicsHeader;

typedef struct {
    KlicsHeader head;                   /* Fixed    - Size and version of this str
    unsigned short  sequence_size[3];   /* Source   - Luminance dimensions and num
    unsigned char   channels;           /* Source   - Number of channels: 3 - YUV,
    unsigned char   sub_sample[2];      /* Source   - UV sub-sampling in X and Y d
    unsigned char   wavelet;            /* Source   - Wavelet used: 0 - Haar, 1 -
    unsigned char   precision;          /* Source   - Bit precision for transform
    unsigned char   octaves[2];         /* Source   - Number of octaves Y/UV (maxi
    unsigned char   reserved[3];        /* Fixed    - Reserved for future use */
} KlicsSeqHeader;

typedef struct {
    KlicsHeader head;                   /* Fixed    - Size and version of this str
    unsigned long   length;             /* Calc     - Length of frame data (bytes)
    unsigned long   frame_number;       /* Calc     - Frame number intended for se
    unsigned char   flags;              /* Calc     - Bitfield flags: 0 - frame sk
    unsigned char   quantizer[5];       /* Calc     - Quantiser shift values[octav
    unsigned short  reserved;           /* Fixed    - Reserved for future use */
} KlicsFrameHeader;

#define KFH_SKIP    0x1
#define KFH_INTRA   0x2

/*
 *  Implementation notes :
 *      QuickTime   Must have KlicsFrameHeader.length set to a valid number
 *      Sun         Must have KlicsSeqHeader in data stream
 *
 *  Possible developments:
 *      KlicsFrameHeader.quantizer
 *          Currently contains shift rather than step-size
 *          Different values for UV and GH,HG,GG sub-bands are not currently suppo
 */
```

=Engineering:KlicsCode:Klics Codec:KlicsEncode.r

```
/*
 *  KlicsEncode resource file
 */


#include "Types.r"
#include "MPWTypes.r"
#include "ImageCodec.r"

/*
 *  Klics Compressor included into the applications resource file here
 */

#define klicsCodecFormatName    "Klics"
#define klicsCodecFormatType    'klic'


/*

    This structure defines the capabilities of the codec. There will
    probably be a tool for creating this resource, which measures the performance
    and capabilities of your codec.

*/
resource 'cdci' (129, "Klics CodecInfo",locked) {
    klicsCodecFormatName,                                   /* name of the codec TYPE ( da
    1,                                                      /* version */
    1,                                                      /* revision */
    'klic',                                                 /* who made this codec */
    0,
    codecInfoDoes32|codecInfoDoes8|codecInfoDoesTemporal,   /* depth and etc suppo
    codecInfoDepth24|codecInfoSequenceSensitive,            /* which data formats do we un
    100,                                                    /* compress accuracy (0-255) (
    100,                                                    /* decompress accuracy (0-255)
    0,                                                      /* millisecs to compress 320x2
    0,                                                      /* millisecs to decompress 320.
    0,                                                      /* compression level (0-255) (
    0,
    32,                                                     /* minimum height */
    32,                                                     /* minimum width */
    0,
    0,
    0
};

resource 'thng' (128, "Klics Compressor",locked) {
    compressorComponentType,
    klicsCodecFormatType,
    'klic',
    codecInfoDoes32|codecInfoDoes8|codecInfoDoesTemporal,
    0,
    'cdec',
    128,
    'STR ',
    128,
    'STR ',
    129,
    'ICON',
    128
};

resource 'STR ' (128) {
    "Klics Compress"
```

```
                => Engineering:KlicsCode:Klics Codec:KlicsEncode.r
);

resource 'STR ' (129) {
    'Wavelet transform & multiresolution tree based coding scheme'
};
```

Engineering:KlicsCode:Klics Codec:KlicsDecode.r

```
/*
 *  KlicsDecode resource file
 */


#include "Types.r"
#include "MPWTypes.r"
#include "ImageCodec.r"

/*
 *  Klics Compressor included into the applications resource file here
 */

#define klicsCodecFormatName    "Klics"
#define klicsCodecFormatType    'klic'


/*

    This structure defines the capabilities of the codec. There will
    probably be a tool for creating this resource, which measures the performance
    and capabilities of your codec.

*/
resource 'cdci' (129, "Klics CodecInfo",locked) {
    klicsCodecFormatName,                                   /* name of the codec TYPE ( da
    1,                                                      /* version */
    1,                                                      /* revision */
    'klic',                                                 /* who made this codec */
    codecInfoDoes32|codecInfoDoes16|codecInfoDoes8|codecInfoDoesTemporal|codecInfo
    0,
    codecInfoDepth24|codecInfoSequenceSensitive,            /* which data formats do we un
    100,                                                    /* compress accuracy (0-255) (
    100,                                                    /* decompress accuracy (0-255)
    0,                                                      /* millisecs to compress 320x2
    0,                                                      /* millisecs to decompress 320
    0,                                                      /* compression level (0-255) (
    0,
    32,                                                     /* minimum height */
    32,                                                     /* minimum width */
    0,
    0,
    0
};

resource 'thng' (130,  "Klics Decompressor",locked) {
    decompressorComponentType,
    klicsCodecFormatType,
    'klic',
    codecInfoDoes32|codecInfoDoes16|codecInfoDoes8|codecInfoDoesTemporal|codecInfo
    0,
    'cdec',
    128,
    'STR ',
    130,
    'STR ',
    131,
    'ICON',
    130
};


resource 'STR ' (130) {
```

CLAIMS

WE CLAIM:

1. A method of transforming a sequence of input digital data values into a first sequence of transformed digital data values and of inverse transforming a second sequence of transformed digital data values into a sequence of output digital data values, said sequence of input digital data values comprising a boundary subsequence and a non-boundary subsequence, comprising the steps of:

running a number of said input digital data values of said boundary subsequence through a low pass boundary forward transform perfect reconstruction digital filter and through a high pass boundary forward transform perfect reconstruction digital filter to produce a first subsequence of said first sequence of transformed digital data values, said first subsequence of said first sequence of transformed digital data values comprising interleaved low and high frequency transformed digital data values;

running a number of said input digital data values of said non-boundary subsequence through a low pass non-boundary forward transform perfect reconstruction digital filter and also through a high pass non-boundary forward transform perfect reconstruction digital filter to produce a second subsequence of said first sequence of transformed digital data values, said second subsequence of said first sequence of transformed digital data values comprising interleaved low and high frequency transformed digital data values, said low pass boundary forward transform perfect reconstruction digital filter having a fewer number of coefficients than said low pass non-boundary forward transform perfect reconstruction digital filter, said high pass boundary forward transform perfect reconstruction digital filter having a fewer number of coefficients

than said high pass non-boundary forward transform perfect reconstruction digital filter;

converting said first sequence of transformed digital data values into said second sequence of transformed digital data values, said second sequence of transformed digital data values comprising a first subsequence of said second sequence of transformed digital data values and a second subsequence of said second sequence of transformed digital data values;

running a number of said first subsequence of said second sequence of transformed digital data values through an interleaved boundary inverse transform perfect reconstruction digital filter to produce at least one output digital data value;

running a number of said second subsequence of said second sequence of transformed digital data values through a first interleaved non-boundary inverse transform perfect reconstruction digital filter to produce output digital data values; and

running a number of said second subsequence of transformed digital data values through a second interleaved non-boundary inverse transform perfect reconstruction digital filter to produce output digital data values, said output digital data values produced by said interleaved boundary inverse transform perfect reconstruction digital filter, said first interleaved non-boundary inverse transform perfect reconstruction digital filter, and said second interleaved non-boundary inverse transform perfect reconstruction digital filter comprising a subsequence of said output digital data values of said sequence of output digital data values.

2. The method of Claim 1, wherein said low pass boundary forward transform perfect reconstruction digital filter has X coefficients and wherein said low pass non-boundary forward transform perfect reconstruction digital

filter has Y coefficients, Y being greater than X, said X coefficients of said low pass boundary forward transform perfect reconstruction digital filter being chosen so that said low pass boundary forward transform perfect reconstruction digital filter outputs a transformed digital data value H_0 when the low pass boundary forward perfect transform reconstruction digital filter operates on input digital data values ID_0-ID_{X-1} adjacent said boundary, said transformed digital data value H_0 being substantially equal to what the output of the low pass non-boundary forward transform perfect reconstruction digital filter would be were the low pass non-boundary forward perfect reconstruction digital filter to operate on ID_0-ID_{X-1} as well as Y-X additional input digital data values outside said boundary, said additional input digital data values having preselected values.

3. The method of Claim 2, wherein Y-X=1, wherein there is one additional input digital data value ID_{-1}, and wherein ID_{-1} is preselected to be substantially equal to ID_0.

4. The method of Claim 2, wherein Y-X=1, wherein there is one additional input digital data value ID_{-1}, and wherein ID_{-1} is preselected to be substantially equal to zero.

5. The method of Claim 1, wherein said sequence of input digital data values is a sequence of digital data values associated with pixels of either a row or a column of a two dimensional image, said boundary of said sequence of input digital data values corresponding with either a start or an end of said row or said column.

6. The method of Claim 1, wherein said sequence of input digital data values is a sequence of digital data values associated with an audio signal.

7. The method of Claim 1, wherein said low and high pass non-boundary forward transform perfect reconstruction digital filters are forward transform quasi-perfect reconstruction filters which have coefficients which approximate the coefficients of true forward transform perfect reconstruction filters.

8. The method of Claim 1, wherein said low and high pass non-boundary forward transform perfect reconstruction digital filters are both four coefficient quasi-Daubechies filters the coefficients of which approximate the coefficients of true four coefficient Daubechies filters.

9. The method of Claim 8, wherein one of said four coefficient quasi-Daubechies filters has the coefficients 11/32, 19/32, 5/32 and 3/32 independent of sign.

10. The method of Claim 1, wherein said low pass non-boundary forward transform perfect reconstruction digital filter is a four coefficient quasi-Daubechies filter H of the form:

$$H_n = aID_{2n-1} + bID_{2n} + cID_{2n+1} - dID_{2n+2}$$

n being a positive integer, ID_0-ID_m being input digital data values, m being a positive integer, ID_0 being the first input digital data value in said sequence of input digital data values, and wherein said low pass boundary forward transform perfect reconstruction digital filter is a three coefficient digital filter of the form:

$$H_0 = aID_{-1} + bID_0 + cID_1 - dID_2$$

ID_{-1} being a predetermined input digital data value outside said boundary and having a preselected value.

11. The method of Claim 10, wherein said high pass

non-boundary forward transform perfect reconstruction digital filter is a four coefficient quasi-Daubechies filter of the form:

$$G_n = dID_{2n-1} + cID_{2n} - bID_{2n+1} + aID_{2n+2}$$

n being a positive integer, and wherein said high pass boundary forward transform perfect reconstruction digital filter is a three coefficient digital filter of the form:

$$G_0 = dID_{-1} + cID_0 - bID_1 + aID_2$$

dID_{-1} having a preselected value.

12. The method of Claim 11, wherein: a + b + c - d is substantially equal to 1, wherein a - b + c + d is substantially equal to 0, and wherein ac - bd is substantially equal to zero.

13. The method of Claim 12, wherein: a=11/32, b=19/32, c=5/32 and d=3/32.

14. The method of Claim 11, wherein said interleaved boundary inverse transform perfect reconstruction digital filter is a two coefficient digital filter of the form:

$$OD_0 = 4(b-a)H_0 + 4(c-d)G_0$$

wherein OD_0 is an output digital data value of said sequence of output digital data values, wherein G_0 is the output of said high pass boundary forward transform perfect reconstruction digital filter when the high pass boundary forward transform perfect reconstruction digital filter operates on input digital data values ID_0, ID_1 and ID_2 adjacent said boundary, and wherein H_0 is the output of said low pass boundary forward transform perfect reconstruction digital filter when the low pass boundary

forward transform perfect reconstruction digital filter operates on input digital data values ID_0, ID_1 and ID_2 adjacent said boundary.

15. The method of Claim 14, wherein one of said first and second interleaved non-boundary inverse transform perfect reconstruction digital filters is of the form:

$$D_{2n+1} = 2(cH_n - bG_n + aH_{n+1} + dG_{n+1})$$

n being a non-negative integer, and wherein the other of said first and second interleaved non-boundary inverse perfect reconstruction digital filters is of the form:

$$D_{2n+2} = 2(-dH_n + aG_n + bH_{n+1} + cG_{n+1})$$

n being a non-negative integer, wherein H_n, G_n, H_{n+1} and G_{n+1} comprise a subsequence of said second sequence of transformed digital data values.

16. The method of Claim 1, wherein said low pass non-boundary forward transform perfect reconstruction digital filter is a four coefficient quasi-Daubechies filter having the coefficients: 11/32, 19/32, 5/32 and -3/32, and wherein said high pass non-boundary forward transform perfect reconstruction digital filter is a four coefficient quasi-Daubechies filter having the coefficients: 3/32, 5/32, -19/32 and 11/32.

17. The method of Claim 1, wherein said low and high pass non-boundary forward transform perfect reconstruction digital filters are chosen from the group consisting of: true six coefficient Daubechies filters and quasi-Daubechies filters, the coefficients of the quasi-Daubechies filters approximating the coefficients of true six coefficient Daubechies filters.

18. The method of Claim 1, further comprising the steps of:

encoding said first sequence of transformed digital data values into an encoded sequence; and

decoding said encoded sequence of digital data values into said second sequence of transformed digital data values and supplying said second sequence of transformed digital data values to said interleaved boundary inverse transform perfect reconstruction digital filter, said first interleaved non-boundary inverse transform perfect reconstruction digital filter, and said second interleaved non-boundary inverse transform perfect reconstruction digital filter.

19. The method of Claim 18, further comprising the step of:

quantizing each of said digital data values in said first sequence of transformed values before said encoding step.

20. The method of Claim 1, wherein each of said input digital data values of said sequence of input digital data values is stored in a separate memory location, and wherein some of said memory locations are overwritten in a sequence with said sequence of transformed digital data values as said digital data input values are transformed into said transformed digital data values.

21. A method of transforming a sequence of input digital data values into a sequence of transformed digital data values, said sequence of input digital data values comprising a boundary subsequence and a non-boundary subsequence, comprising the steps of:

running a number of said input digital data values of said boundary subsequence through a low pass boundary forward transform perfect reconstruction

digital filter and through a high pass boundary forward transform perfect reconstruction digital filter to produce a first subsequence of said sequence of transformed digital data values, said first subsequence of said sequence of transformed digital data values comprising interleaved low and high frequency transformed digital data values; and

running a number of said input digital data values of said non-boundary subsequence through a low pass non-boundary forward transform perfect reconstruction digital filter and also through a high pass non-boundary forward transform perfect reconstruction digital filter to produce a second subsequence of said sequence of transformed digital data values, said second subsequence of said sequence of transformed digital data values comprising interleaved low and high frequency transformed digital data values, said low pass boundary forward transform perfect reconstruction digital filter having a fewer number of coefficients than said low pass non-boundary forward transform perfect reconstruction digital filter, said high pass boundary forward transform perfect reconstruction digital filter having a fewer number of coefficients than said high pass non-boundary forward transform perfect reconstruction digital filter.

22. A method, comprising the steps of:

generating a sub-band decomposition having a plurality of octaves, a first of said plurality of octaves comprising at least one first digital data value, a second of said plurality of octaves comprising at least one second digital data value;

calculating a sum of the absolute values of said at least one first digital data value;

determining if said at least one first digital data value is interesting using a first threshold

limit;

calculating a sum of the absolute values of said at least one second digital data value; and

determining if said at least one second digital data value is interesting using a second threshold limit.

23. A method of traversing a tree decomposition, said tree decomposition comprising a plurality of transformed data values, each of said plurality of transformed data values having a unique address identified by coordinates X and Y, comprising the step of:

calculating at least four transformed data value addresses by incrementing a count, the count comprising one bit $C1_x$ in the X coordinate and one bit $C1_y$ in the Y coordinate, to generate said at least four transformed data value addresses.

24. A method, comprising the step of:

determining an address of a transformed data value in a tree decomposition by shifting a value a number of times, said tree decomposition having a number of octaves, said transformed data value being in one of said octaves, said number of times being at least dependent upon said one octave.

25. A method, comprising the step of:

determining an address of a transformed data value in a tree decomposition by multiplying a value by a factor, said tree decomposition having a number of octaves, said transformed data value being in one of said octaves, said factor being at least dependent upon said one octave.

26. A method, comprising the step of:

determining an address of a transformed data value in a tree decomposition by shifting a value a number of times, said tree decomposition having a number of frequency sub-

bands, said transformed data value being in one of said frequency sub-bands, said number of times being at least dependent upon said frequency sub-band.

27. A method, comprising the step of:

determining an address of a transformed data value in a tree decomposition by performing a logical operation upon a value, said tree decomposition having a number of frequency sub-bands, said transformed data value being in one of said frequency sub-bands, said logical operation performed being at least dependent upon said one frequency sub-band.

28. The method of Claim 27, wherein said logical operation is a bit-wise logical AND operation.

29. A method for determining a low pass quasi-perfect reconstruction filter and a high pass quasi-perfect reconstruction filter from a wavelet function, said low pass quasi-perfect reconstruction filter having a plurality of coefficients, said high pass quasi-perfect reconstruction filter having a plurality of coefficients, comprising the steps of:

determining a low pass wavelet digital filter and a high pass wavelet digital filter from said wavelet function, said low pass wavelet digital filter having a plurality of coefficients, said high pass wavelet digital filter having a plurality of coefficients;

choosing the coefficients of said low pass quasi-perfect reconstruction digital filter to be fractions such that when a sequence of data values having values of 1 is processed by said low pass quasi-perfect reconstruction digital filter the output of said low pass quasi-perfect reconstruction digital filter is exactly a power of 2; and

choosing the coefficients of the high pass quasi-perfect reconstruction digital filter to be fractions such that when a sequence of data values having values of 1 is

processed by said high pass quasi-perfect reconstruction digital filter the output of said high pass quasi-perfect reconstruction digital filter is exactly 0, whereby each of the plurality of coefficients of said low pass quasi-perfect reconstruction digital filter is substantially identical to a corresponding one of said plurality of coefficients of said low pass wavelet digital filter, and whereby each of the plurality of coefficients of said high pass quasi-perfect reconstruction digital filter is substantially identical to a corresponding one of said plurality of coefficients of said high pass wavelet digital filter.

30. A method of estimating a compression ratio of a number of original data values to a number of compressed data values at a value of a quality factor Q, comprising the steps of:

examining a first block of transformed data values of a tree, said first block being one of a number of lowest frequency blocks of a high pass component sub-band, said tree being part of a sub-band decomposition; and

determining a value of said quality factor Q at which said data values of said first block would be converted into compressed data values, and not determining a value of said quality factor Q at which any other block of data values of said tree would be converted into a number of compressed data values.

31. The method of Claim 30, wherein said number of original data values represents a frame of an image.

32. The method of Claim 31, further comprising the step of:

determining a number of lowest frequency blocks of said high pass component sub-band which would be converted into compressed data values given a value of said quality factor Q.

33. A method of transforming a sequence of image data values, comprising the step of:

filtering said sequence of image data values using a quasi-perfect reconstruction filter to generate a decomposition having a plurality of octaves, said quasi-perfect reconstruction filter having six coefficients.

34. The method of Claim 33, wherein said six coefficients are selected from the group consisting of: 30/128, 73/128, 41/128, 12/128, 7/128 and 3/128, irrespective of sign.

35. A method of detecting motion in a tree decomposition, said tree decomposition comprising a plurality of octaves of blocks of data values, comprising the steps of:

comparing data values of a first block in an octave with data values of a second block in said octave; and

generating a token indicating motion based on said comparing.

36. A method, comprising the steps of:

generating a sub-band decomposition having a plurality of octaves, a first of said plurality of octaves comprising at least one first digital data value, a second of said plurality of octaves comprising at least one second digital data value;

determining if said at least one first digital data value is interesting using a first threshold limit; and

determining if said at least one second digital data value is interesting using a second threshold limit.

37. A method, comprising the steps of:

generating a sub-band decomposition of a first frame having a plurality of octaves, a first of said plurality of octaves comprising at least one first digital data value, a

second of said plurality of octaves comprising at least one second digital data value;

generating a sub-band decomposition of a second frame having a plurality of octaves, a first of said plurality of octaves comprising at least one first digital data value, a second of said plurality of octaves comprising at least one second digital data value;

comparing said first digital data value of said first frame with said first digital data value of said second frame using a first threshold compare; and

comparing said second digital data value of said first frame with said second digital data value of said second frame using a second threshold compare.

38. A method, comprising the steps of:

reading a sequence of data values from a plurality of memory locations, each of said data values being stored in a separate one of said plurality of memory locations; and

overwriting some of said memory locations in a sequence as said data values are transformed into a sequence of transformed data values of a sub-band decomposition.

39. A method, comprising the steps of:

performing a function on a plurality of data values of a new block to generate a first output value, said new block being a block of data values of a sub-band decomposition of a new frame;

performing said function on a plurality of numbers to generate a second output value, each of said numbers substantially equalling a difference of a data value in said plurality of data values of said new block and a corresponding data value in a corresponding plurality of data values of an old block, said old block being a block of data values of a sub-band decomposition of an old frame; and

generating a token if said first output value has a

predetermined relationship with respect to said second output value.

40. The method of Claim 39, wherein said token is a SEND_STILL token.

41. A method, comprising the steps of:

performing a function on a plurality of data values of a new block to generate a corresponding plurality of output values, said new block being a block of data values of a sub-band decomposition;

comparing each of said plurality of output values with a predetermined number; and

generating a token if substantially all of said output values have a predetermined relationship with respect to said predetermined number.

42. The method of Claim 41, wherein said token is a VOID token.

43. A method, comprising the steps of:

subtracting each one of a plurality of data values of a new block with a corresponding one of a plurality of data values of a old block to generate a corresponding plurality of output values, said new block being a block of data values of a sub-band decomposition of a new frame, said old block being a block of data values of a sub-band decomposition of a old frame;

comparing each of said plurality of output values with a predetermined number; and

generating a token if substantially all of said output values have a predetermined relationship with respect to said predetermined number.

44. The method of Claim 43, wherein said token is a VOID token.

45. A method, comprising the steps of:

determining an absolute value for each of a plurality of data values of a block of a sub-band decomposition;

determining a sum of said absolute values; and

generating a token based on a comparison of said sum with a predetermined number.

46. The method of Claim 45, wherein said token is a VOID token.

47. A method, comprising the steps of:

processing a sequence of first image data values using a low pass forward transform perfect reconstruction digital filter and a high pass forward transform perfect reconstruction digital filter to create a first sequence of transformed data values, said low pass forward transform perfect reconstruction digital filter and said high pass forward transform perfect reconstruction digital filter each having coefficients chosen from a first group of coefficients independent of sign;

converting said first sequence of transformed data values into a second sequence of transformed data values; and

using digital circuitry to process said second sequence of transformed data values using a low pass inverse transform perfect reconstruction digital filter and a high pass inverse transform perfect reconstruction digital filter into a sequence of second image data values, said low pass inverse transform perfect reconstruction digital filter and said high pass inverse transform perfect reconstruction digital filter each having coefficients chosen from a second group of coefficients independent of sign.

48. The method of claim 47, wherein said digital circuitry used to process said second sequence of transformed data values is a digital computer having a

microprocessor.

49. The method of claim 47, wherein at least one of the coefficients in said first group of coefficients is not contained in said second group of coefficients.

50. The method of claim 47, wherein said first group of coefficients has a different number of coefficients than said second group of coefficients.

51. The method of claim 50, wherein said sequence of first image data values is a sequence of chrominance data values.

52. The method of claim 50, wherein said low pass forward transform perfect reconstruction digital filter and said high pass forward transform perfect reconstruction digital filter each have four coefficients, and wherein said low pass inverse transform perfect reconstruction digital filter and said high pass inverse transform perfect reconstruction digital filter each have two coefficients.

53. The method of claim 52, wherein said sequence of first image data values is a sequence of chrominance data values.

54. The method of claim 47, wherein each of said coefficients of said low pass inverse transform perfect reconstruction digital filter and said high pass inverse transform perfect reconstruction digital filter is selected from the group consisting of: 5/8, 3/8 and 1/8, independent of sign.

55. The method of claim 47, wherein said converting step comprises the steps of:

encoding said first sequence of transformed data values into a compressed data stream; and

decoding said compressed data stream into said second sequence of transformed data values.

56. A method comprising the step of using digital circuitry to process a sequence of image data values using a low pass forward transform perfect reconstruction digital filter and a high pass forward transform perfect reconstruction digital filter to generate a sub-band decomposition, said low pass forward transform perfect reconstruction digital filter and said high pass forward transform perfect reconstruction digital filter each having four coefficients, each of said four coefficients being selected from the group consisting of: 5/8, 3/8 and 1/8, independent of sign.

57. The method of claim 56, wherein said digital circuitry comprises means for low pass forward transform perfect reconstruction digital filtering and for high pass forward transform perfect reconstruction digital filtering.

58. A method comprising the step of using digital circuitry to process a sequence of transformed data values of a sub-band decomposition using an odd inverse transform perfect reconstruction digital filter and an even inverse transform perfect reconstruction digital filter, said odd inverse transform perfect reconstruction digital filter and said even inverse transform perfect reconstruction digital filter each having four coefficients, each of said four coefficients being selected from the group consisting of: 5/8, 3/8 and 1/8, independent of sign.

59. The method of claim 58, wherein said digital circuitry is a digital computer having a microprocessor.

60. A method comprising the step of generating a compressed data stream indicative of a video sequence from a sub-band decomposition, said compressed data stream

comprising a first data value, a first token, a second data value, and a second token, said first token being indicative of a first encoding method used to encode said first data value, said second token being indicative of a second encoding method used to encode said second data value, said first token consisting of a first number of bits and said second token consisting of a second number of bits.

61. The method of claim 60, wherein said first encoding method is taken from the group consisting of: SEND mode, STILL_SEND mode, VOID mode, and STOP mode.

62. The method of claim 60, wherein said first token is a single bit token.

63. A method, comprising the steps of:

forward transforming image data values to generate a first sequence of transformed data values of a first sub-band decomposition, said first sub-band decomposing having a first number of octaves;

converting said first sequence of transformed data values into a second sequence of transformed data values;

using digital circuitry to inverse transforming said second sequence of transformed data values into a third sequence of transformed data values, said third sequence of transformed data values comprising a second sub-band decomposition having a second number of octaves, said second number of octaves being smaller than said first number of octaves, said second sub-band decomposition having a low pass component, said low pass component of said second sub-band decomposition comprising data values indicative of rows of data values of an image, said rows of said image extending in a first dimension, said image also having columns of said data values extending in a second dimension;

expanding said low pass component in said first

dimension using interpolation to generate an interpolated low pass component; and

expanding said interpolated low pass component in said second dimension by replicating rows of said data values of said interpolated low pass component.

64. The method of claim 63, wherein said digital circuitry is a digital computer having a microprocessor.

65. The method of claim 63, wherein said converting step comprises the steps of:

encoding said first sequence of transformed data values into a compressed data stream comprising tokens and encoded data values; and

decoding said compressed data stream into said second sequence of transformed data values.

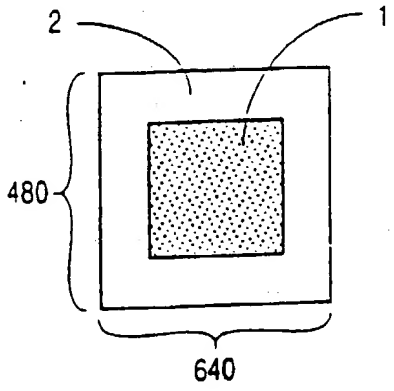

Fig. 1
(PRIOR ART)

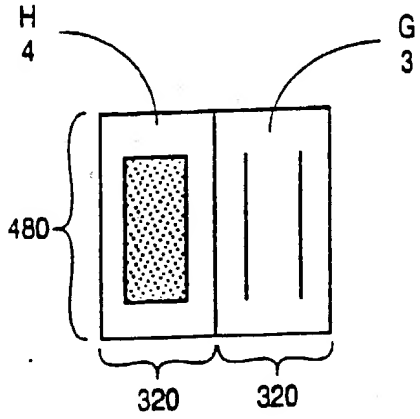

Fig. 2
(PRIOR ART)

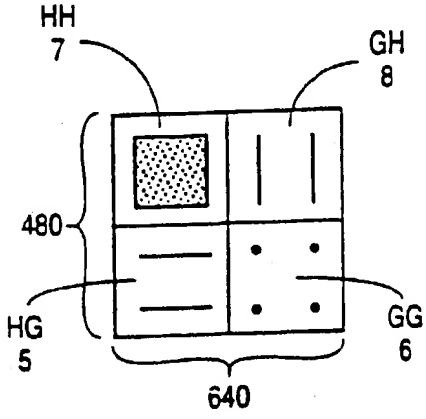

Fig. 3
(PRIOR ART)

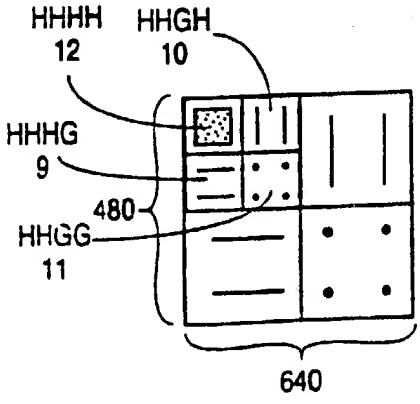

Fig. 4
(PRIOR ART)

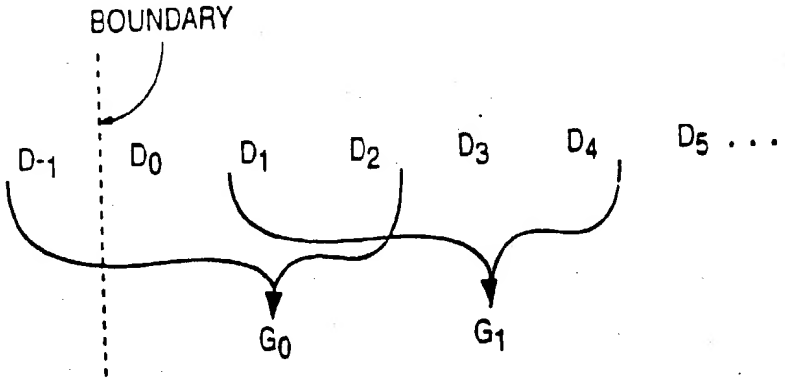

Fig. 5
(PRIOR ART)

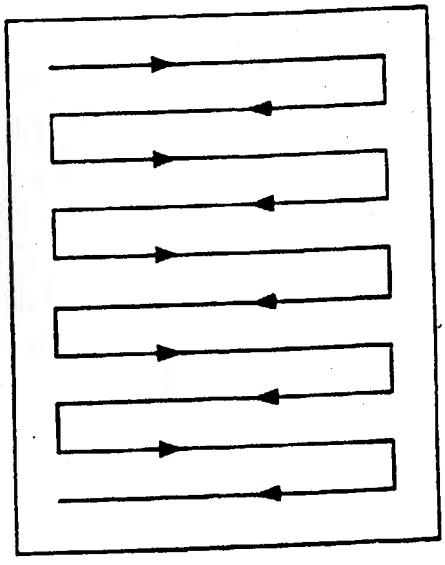

Fig. 6
(PRIOR ART)

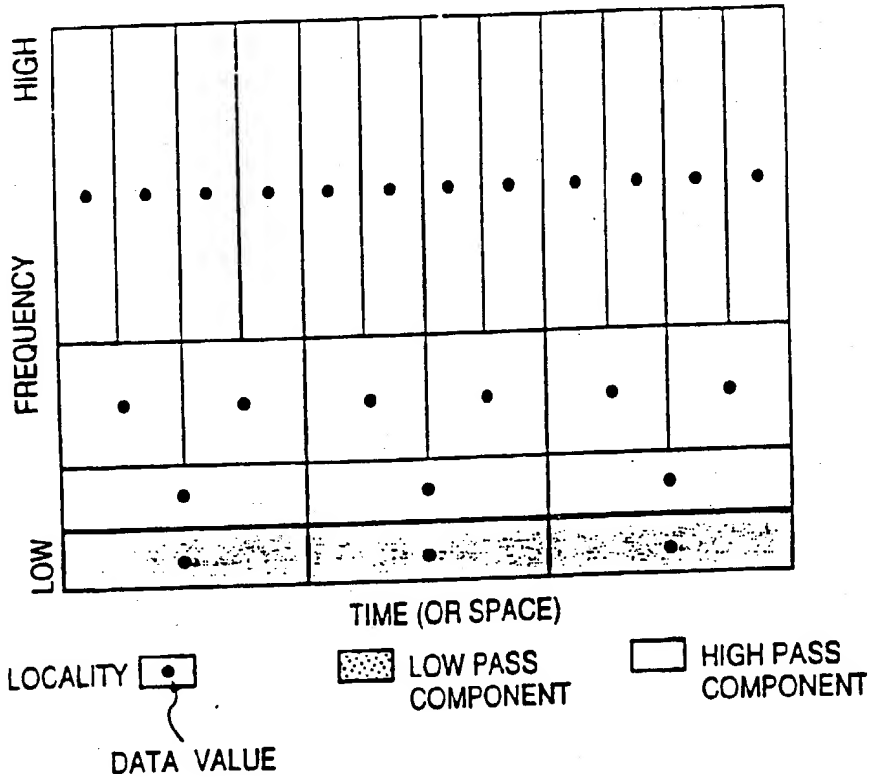

Fig. 7

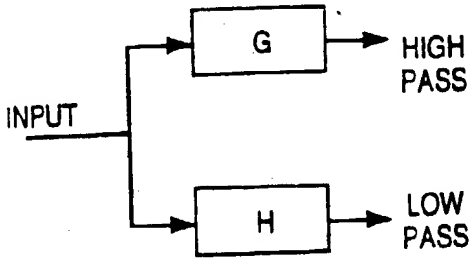

Fig. 8

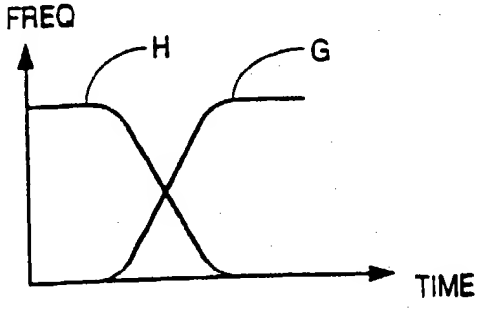

Fig. 9

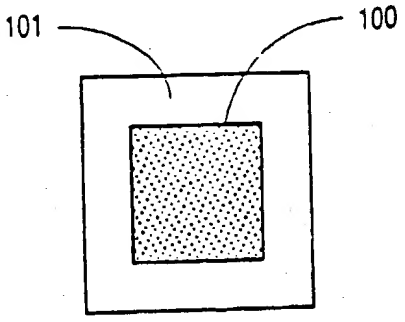

Fig. 10

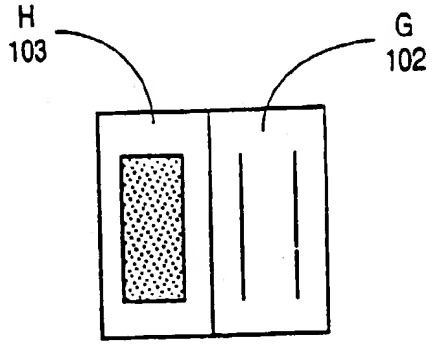

Fig. 11

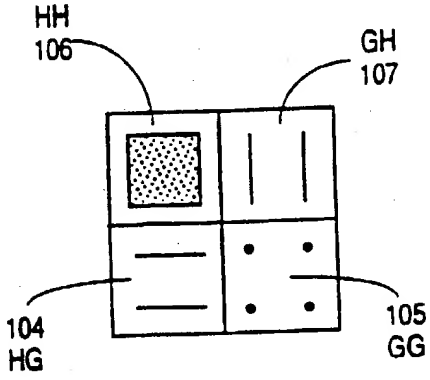

Fig. 14

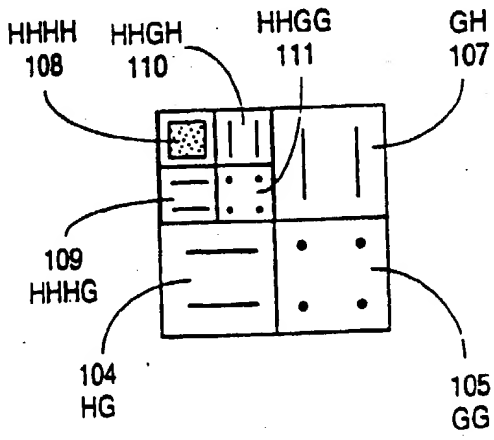

Fig. 15

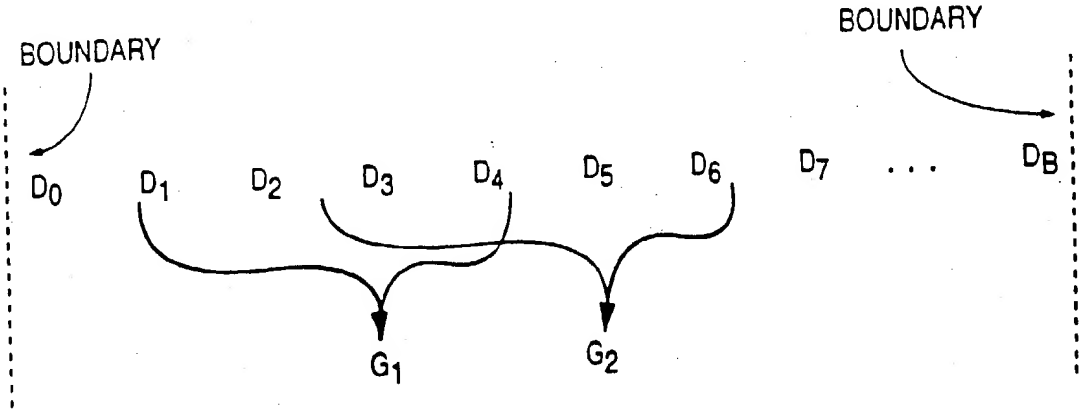
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Fig. 12

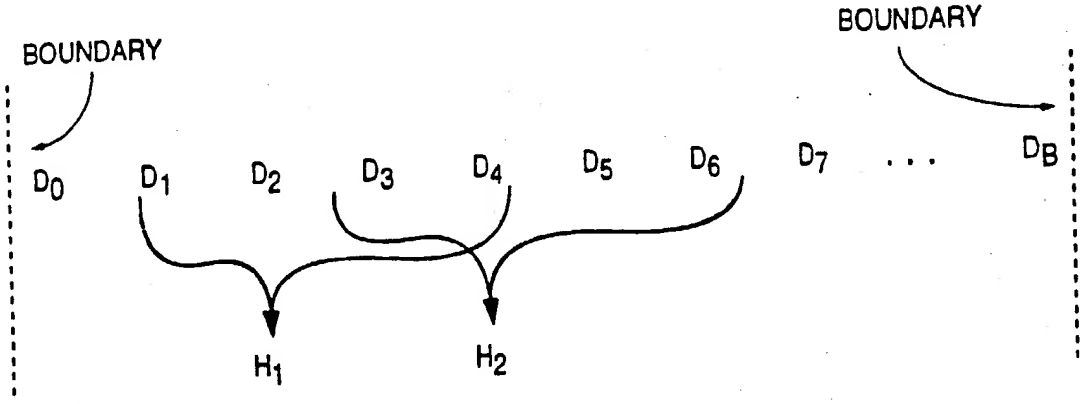
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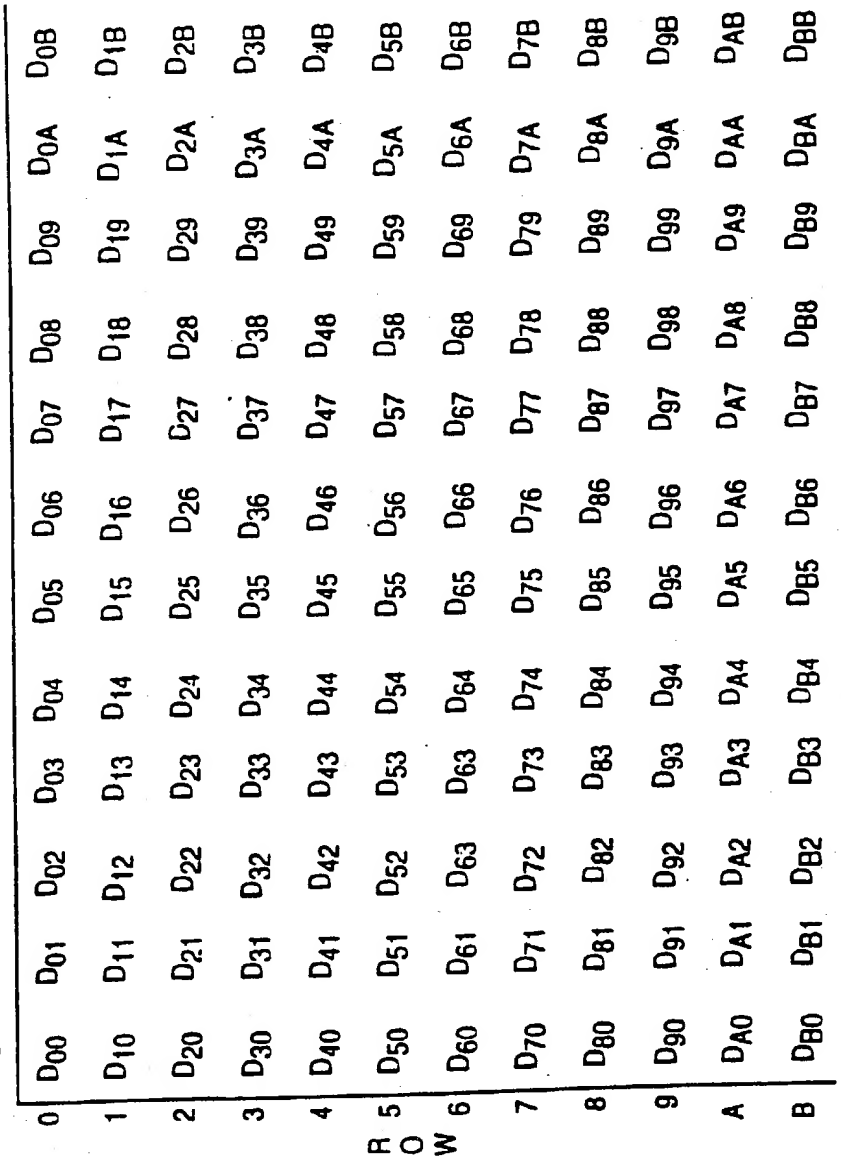
Fig. 13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2 D20 D21 D22 D23 D24 D25 D26 D27 D28 D29 D2A D2B
3 D30 D31 D32 D33 D34 D35 D36 D37 D38 D39 D3A D3B
4 D40 D41 D42 D43 D44 D45 D46 D47 D48 D49 D4A D4B
5 D50 D51 D52 D53 D54 D55 D56 D57 D58 D59 D5A D5B
6 D60 D61 D63 D63 D64 D65 D66 D67 D68 D69 D6A D6B
7 D70 D71 D72 D73 D74 D75 D76 D77 D78 D79 D7A D7B
8 D80 D81 D82 D83 D84 D85 D86 D87 D88 D89 D8A D8B
9 D90 D91 D92 D93 D94 D95 D96 D97 D98 D99 D9A D9B
A DA0 DA1 DA2 DA3 DA4 DA5 DA6 DA7 DA8 DA9 DAA DAB
B DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7 DB8 DB9 DBA DBB

Fig. 16

ROW \ COLUMN	0	1	2	3	4	5	6	7	8	9	A	B
0	HH_{00}	GH_{00}	HH_{01}	GH_{01}	HH_{02}	GH_{02}	HH_{03}	GH_{03}	HH_{04}	GH_{04}	HH_{05}	GH_{05}
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2	HH_{10}	GH_{10}	HH_{11}	GH_{11}	HH_{12}	GH_{12}	HH_{13}	GH_{13}	HH_{14}	GH_{14}	HH_{15}	GH_{15}
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6	HH_{30}	GH_{30}	HH_{31}	GH_{31}	HH_{32}	GH_{32}	HH_{33}	GH_{33}	HH_{34}	GH_{34}	HH_{35}	GH_{35}
7	HG_{30}	GG_{30}	HG_{31}	GG_{31}	HG_{32}	GG_{32}	HG_{33}	GG_{33}	HG_{34}	GG_{34}	HG_{35}	GG_{35}
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9	HG_{40}	GG_{40}	HG_{41}	GG_{41}	HG_{42}	GG_{42}	HG_{43}	GG_{43}	HG_{44}	GG_{44}	HG_{45}	GG_{45}
A	HH_{50}	GH_{50}	HH_{51}	GH_{51}	HH_{52}	GH_{52}	HH_{53}	GH_{53}	HH_{54}	GH_{54}	HH_{55}	GH_{55}
B	HG_{50}	GG_{50}	HG_{51}	GG_{51}	HG_{52}	GG_{52}	HG_{53}	GG_{53}	HG_{54}	GG_{54}	HG_{55}	GG_{55}

Fig. 17

ROW \ COLUMN	0	1	2	3	4	5	6	7	8	9	A	B
0	$HHHH_{00}$	GH_{00}	$HHGH_{00}$	GH_{01}	$HHHH_{01}$	GH_{02}	$HHGH_{01}$	GH_{03}	$HHHH_{02}$	GH_{04}	$HHGH_{02}$	GH_{05}
1	HG_{00}	GG_{00}	HG_{01}	GG_{01}	HG_{02}	GG_{02}	HG_{03}	GG_{03}	HG_{04}	GG_{04}	HG_{05}	GG_{05}
2	$HHHG_{00}$	GH_{10}	$HHGG_{00}$	GH_{11}	$HHHG_{01}$	GH_{12}	$HHGG_{01}$	GH_{13}	$HHHG_{02}$	GH_{14}	$HHGG_{02}$	GH_{15}
3	HG_{10}	GG_{10}	HG_{11}	GG_{11}	HG_{12}	GG_{12}	HG_{13}	GG_{13}	HG_{14}	GG_{14}	HG_{15}	GG_{15}
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9	HG_{40}	GG_{40}	HG_{41}	GG_{41}	HG_{42}	GG_{42}	HG_{43}	GG_{43}	HG_{44}	GG_{44}	HG_{45}	GG_{45}
A	$HHHG_{20}$	GH_{50}	$HHGG_{20}$	GH_{51}	$HHHG_{21}$	GH_{52}	$HHGG_{21}$	GH_{53}	$HHHG_{22}$	GH_{54}	$HHGG_{22}$	GH_{55}
B	HG_{50}	GG_{50}	HG_{51}	GG_{51}	HG_{52}	GG_{52}	HG_{53}	GG_{53}	HG_{54}	GG_{54}	HG_{55}	GG_{55}

Fig. 18

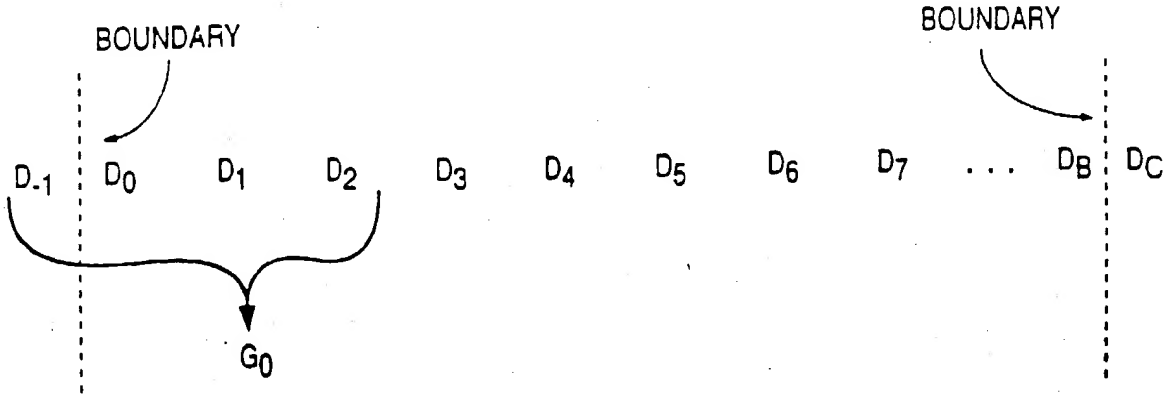
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Fig. 19

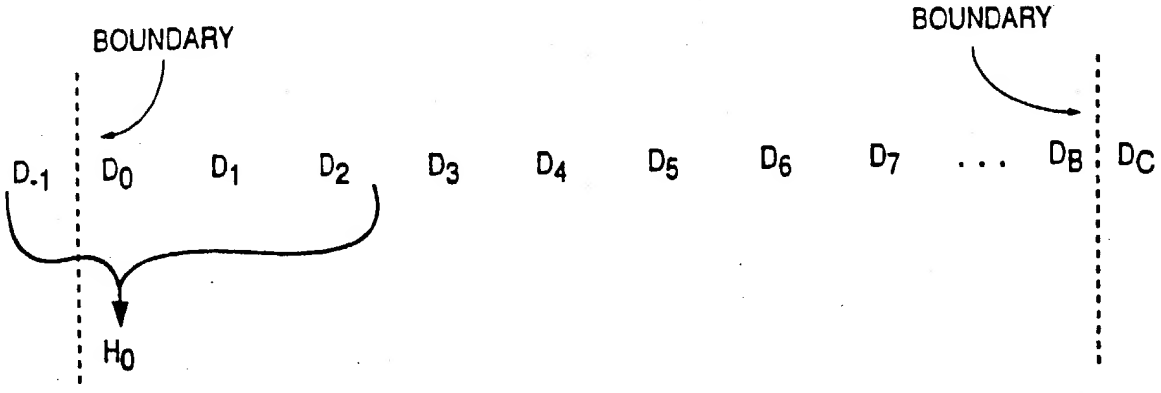
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Fig. 20

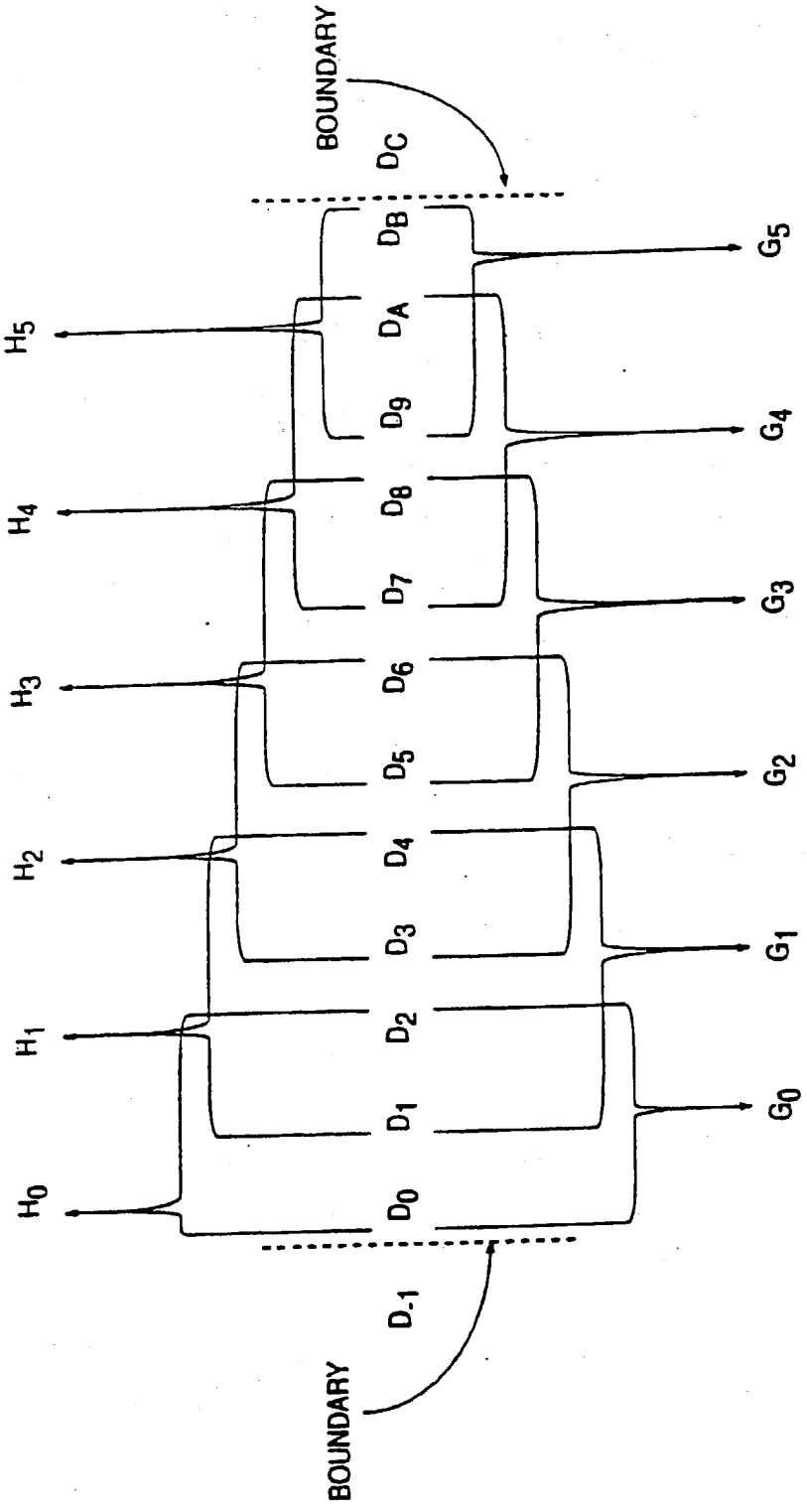
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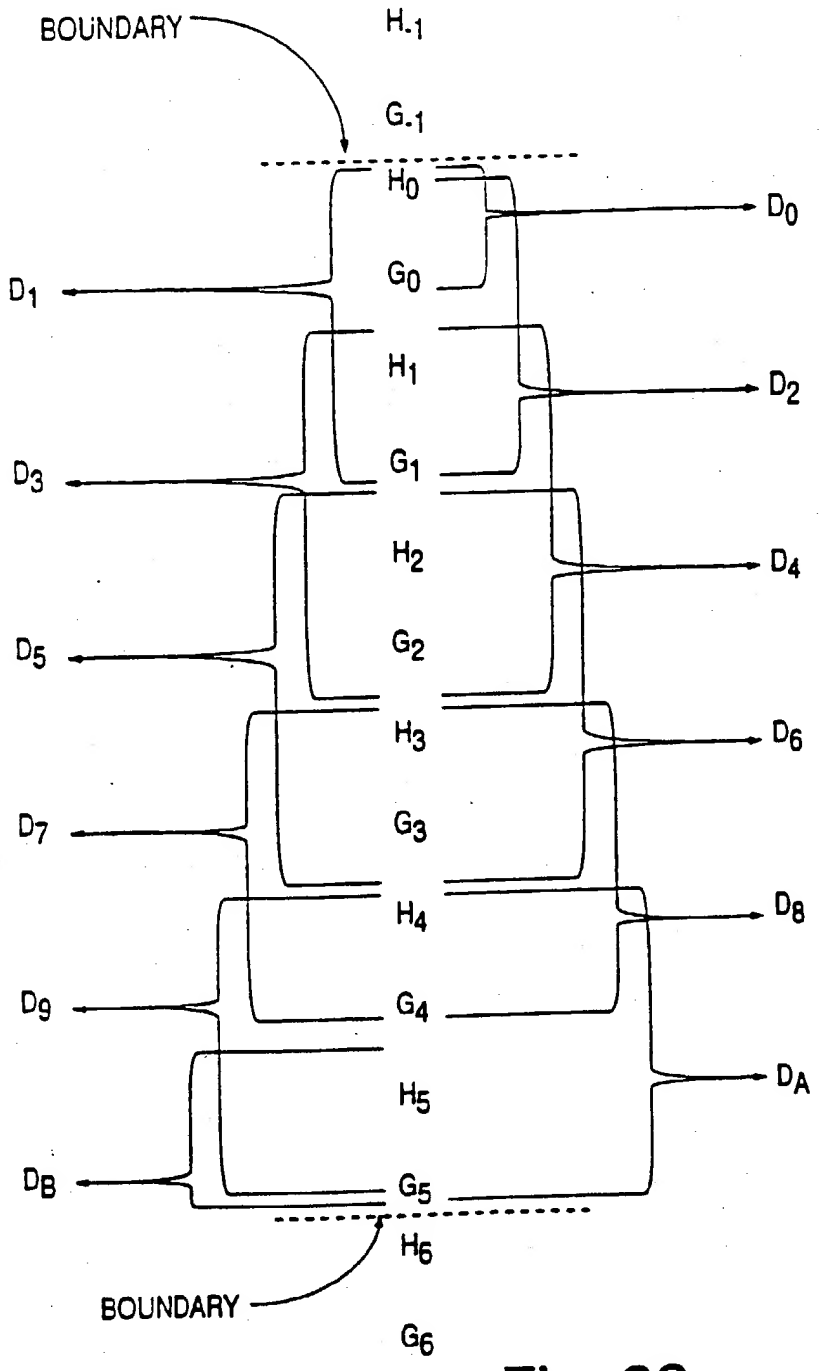
Fig. 21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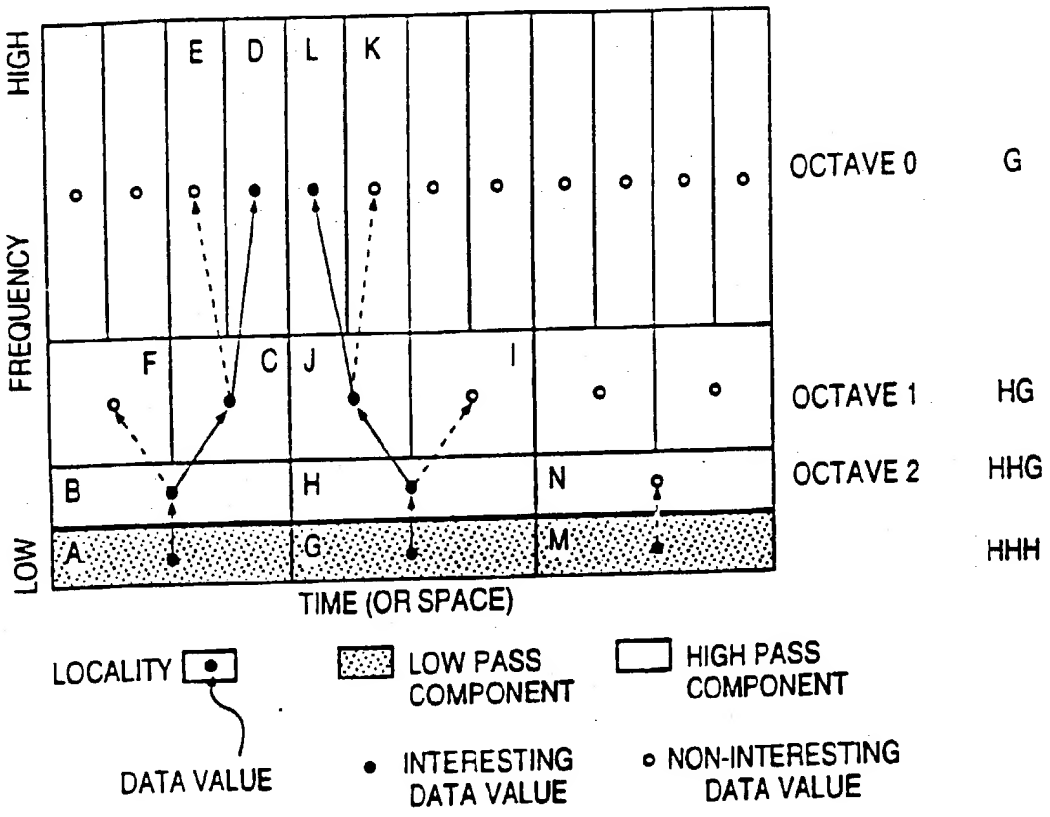
G6

Fig. 22


HIGH
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HG
OCTAVE 2
HHG
HHH
TIME (OR SPACE)
LOCALITY
DATA VALUE
LOW PASS COMPONENT
HIGH PASS COMPONENT
INTERESTING DATA VALUE
NON-INTERESTING DATA VALUE

Fig. 23

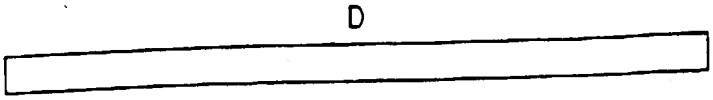


Fig. 24A

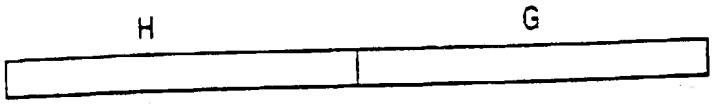


Fig. 24B

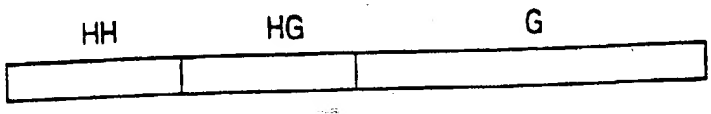


Fig. 24C

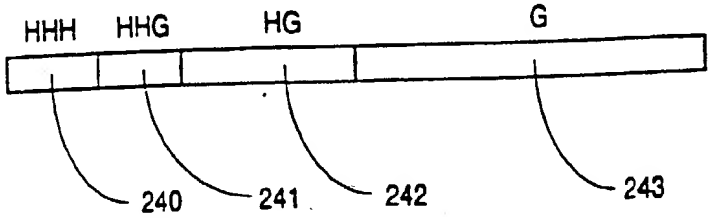


Fig. 24D

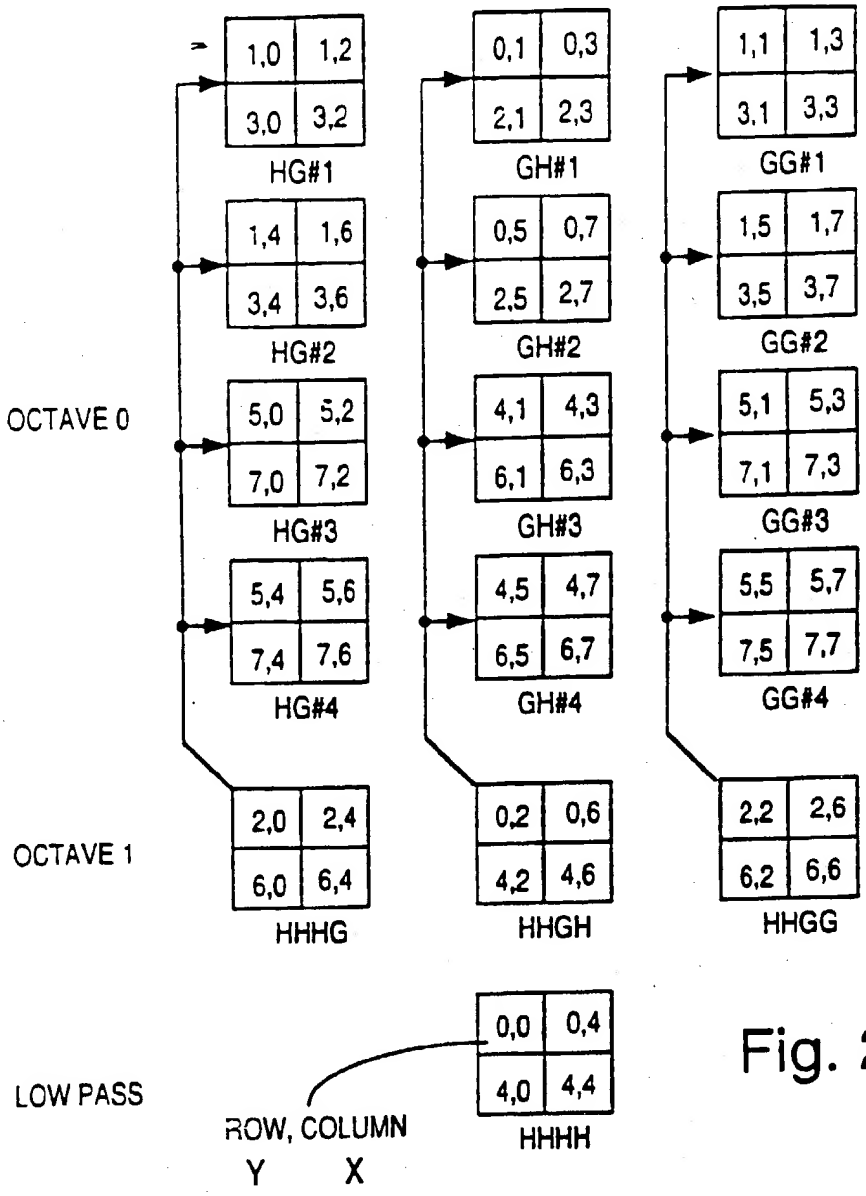
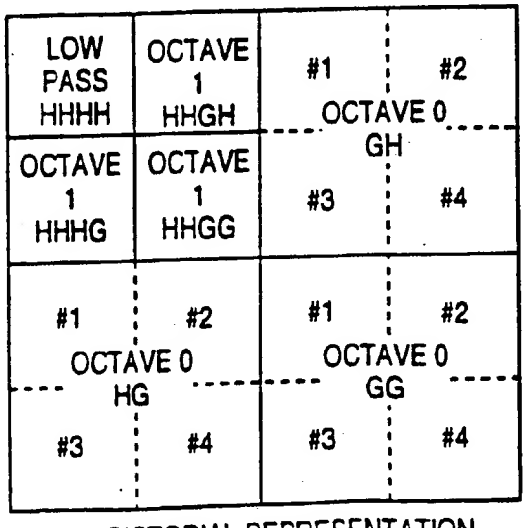


Fig. 25



PICTORIAL REPRESENTATION

Fig. 26

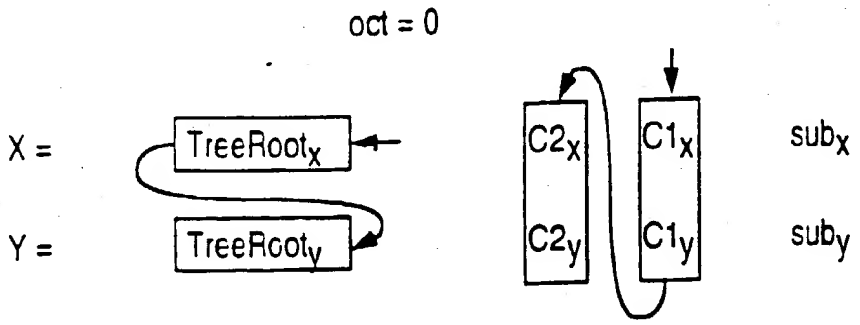


Fig. 27

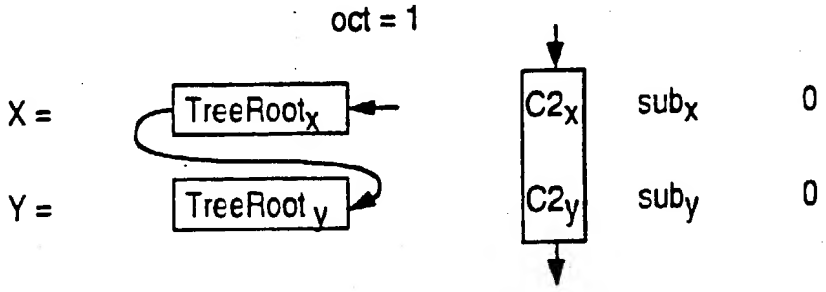


Fig. 28

	sub-band	sub$_X$	sub$_Y$
low pass	HH	0	0
high pass	HG	0	1
high pass	GH	1	0
high pass	GG	1	1

Fig. 29

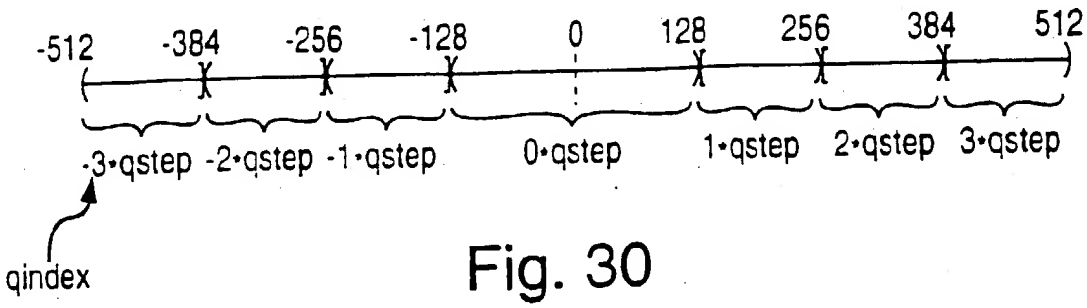

-512
-384
-256
-128
0
128
256
384
512
-3•qstep
-2•qstep
-1•qstep
0•qstep
1•qstep
2•qstep
3•qstep
qindex

Fig. 30

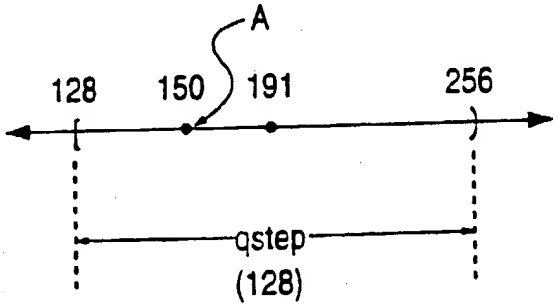

A
128
150
191
256
qstep
(128)

Fig. 31

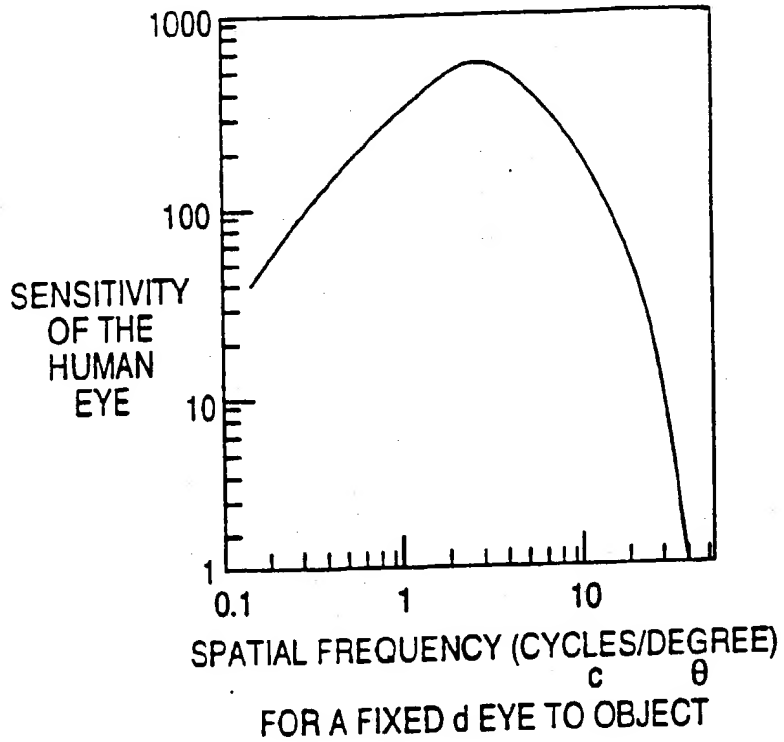

1000
100
10
1
SENSITIVITY OF THE HUMAN EYE
0.1
1
10
SPATIAL FREQUENCY (CYCLES/DEGREE)
c
θ
FOR A FIXED d EYE TO OBJECT

Fig. 32

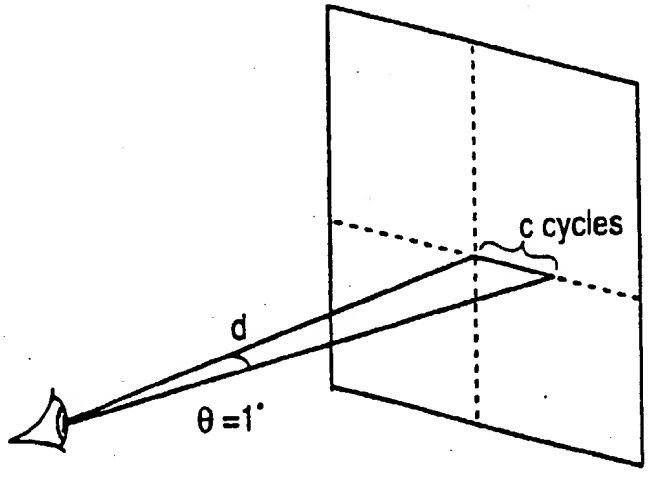

c cycles
d
θ =1°

Fig. 33

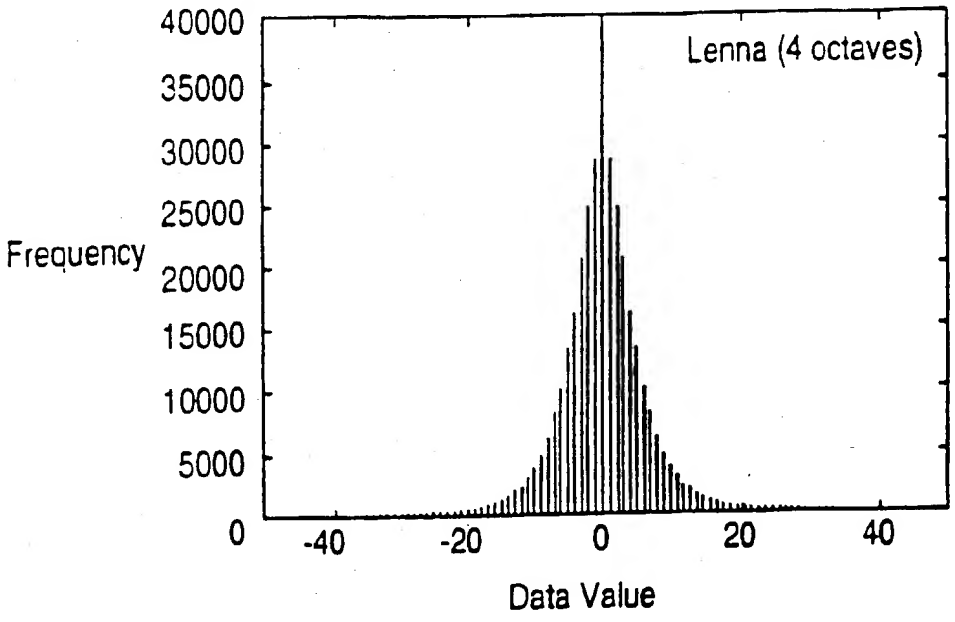

Lenna (4 octaves)
Frequency
40000
35000
30000
25000
20000
15000
10000
5000
0
-40
-20
0
20
40
Data Value

Fig. 34

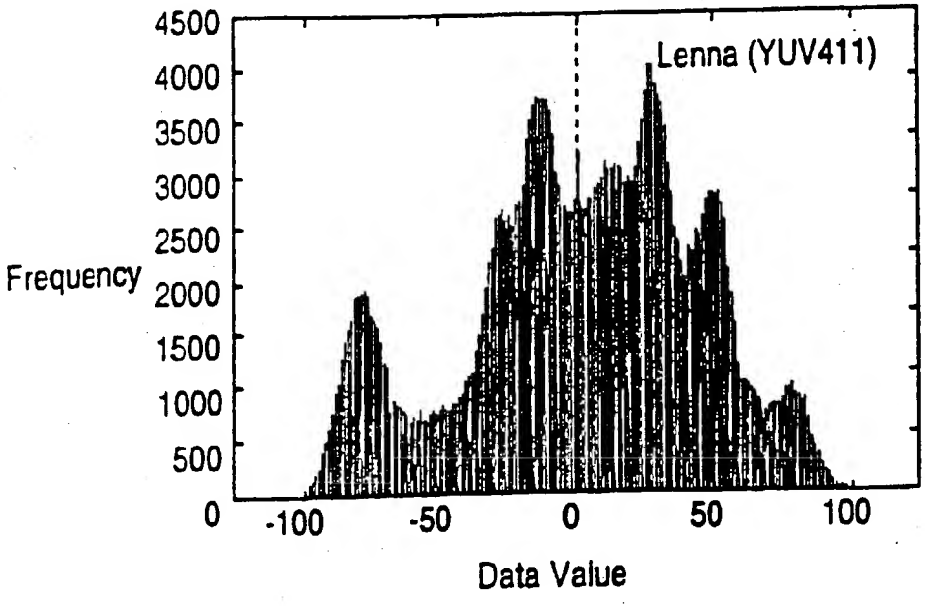

Lenna (YUV411)
Frequency
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-100
-50
0
50
100
Data Value

Fig. 35

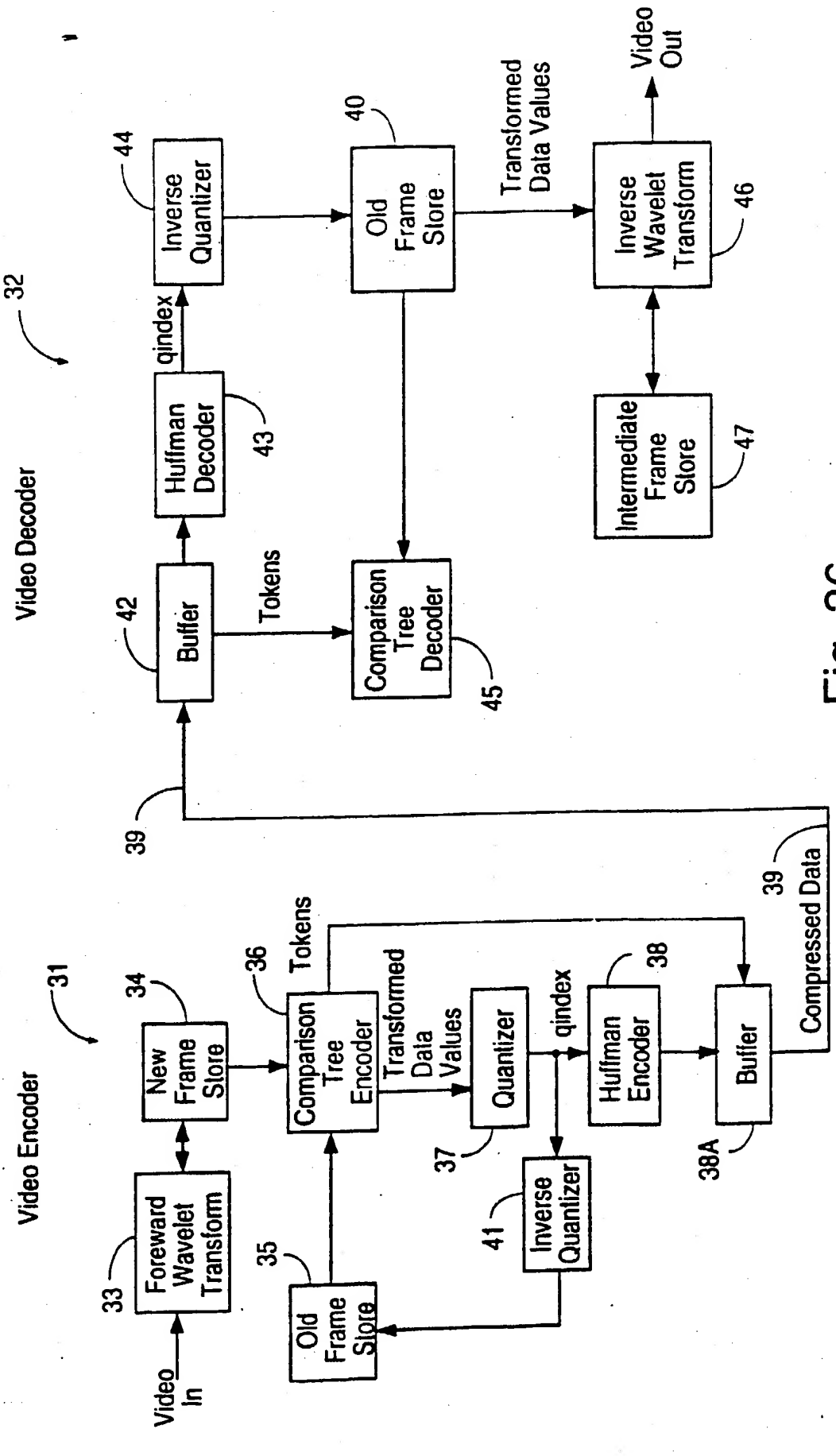

Video Encoder
31
Video In
Foreward Wavelet Transform
33
New Frame Store
34
Old Frame Store
35
Comparison Tree Encoder
36
Tokens
Transformed Data Values
Quantizer
37
qindex
Inverse Quantizer
41
Huffman Encoder
38
Buffer
38A
Compressed Data
39
Video Decoder
32
Buffer
42
Tokens
Comparison Tree Decoder
45
Huffman Decoder
43
qindex
Inverse Quantizer
44
Old Frame Store
40
Transformed Data Values
Inverse Wavelet Transform
46
Intermediate Frame Store
47
Video Out

Fig. 36

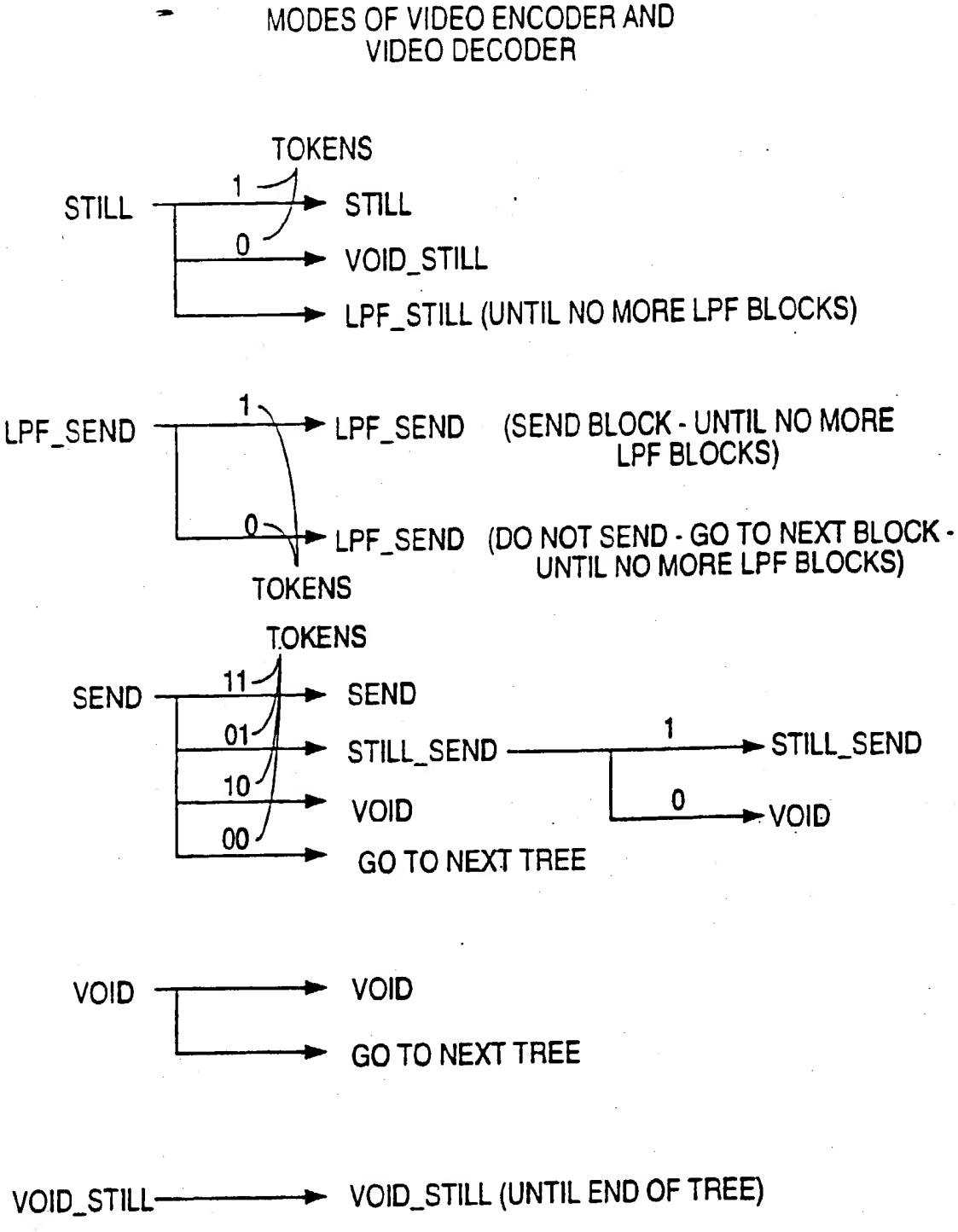

MODES OF VIDEO ENCODER AND VIDEO DECODER
TOKENS
STILL
1
STILL
0
VOID_STILL
LPF_STILL (UNTIL NO MORE LPF BLOCKS)
LPF_SEND
1
LPF_SEND (SEND BLOCK - UNTIL NO MORE LPF BLOCKS)
0
LPF_SEND (DO NOT SEND - GO TO NEXT BLOCK - UNTIL NO MORE LPF BLOCKS)
TOKENS
TOKENS
SEND
11
SEND
01
STILL_SEND
1
STILL_SEND
10
VOID
0
VOID
00
GO TO NEXT TREE
VOID
VOID
GO TO NEXT TREE
VOID_STILL
VOID_STILL (UNTIL END OF TREE)

Fig. 37

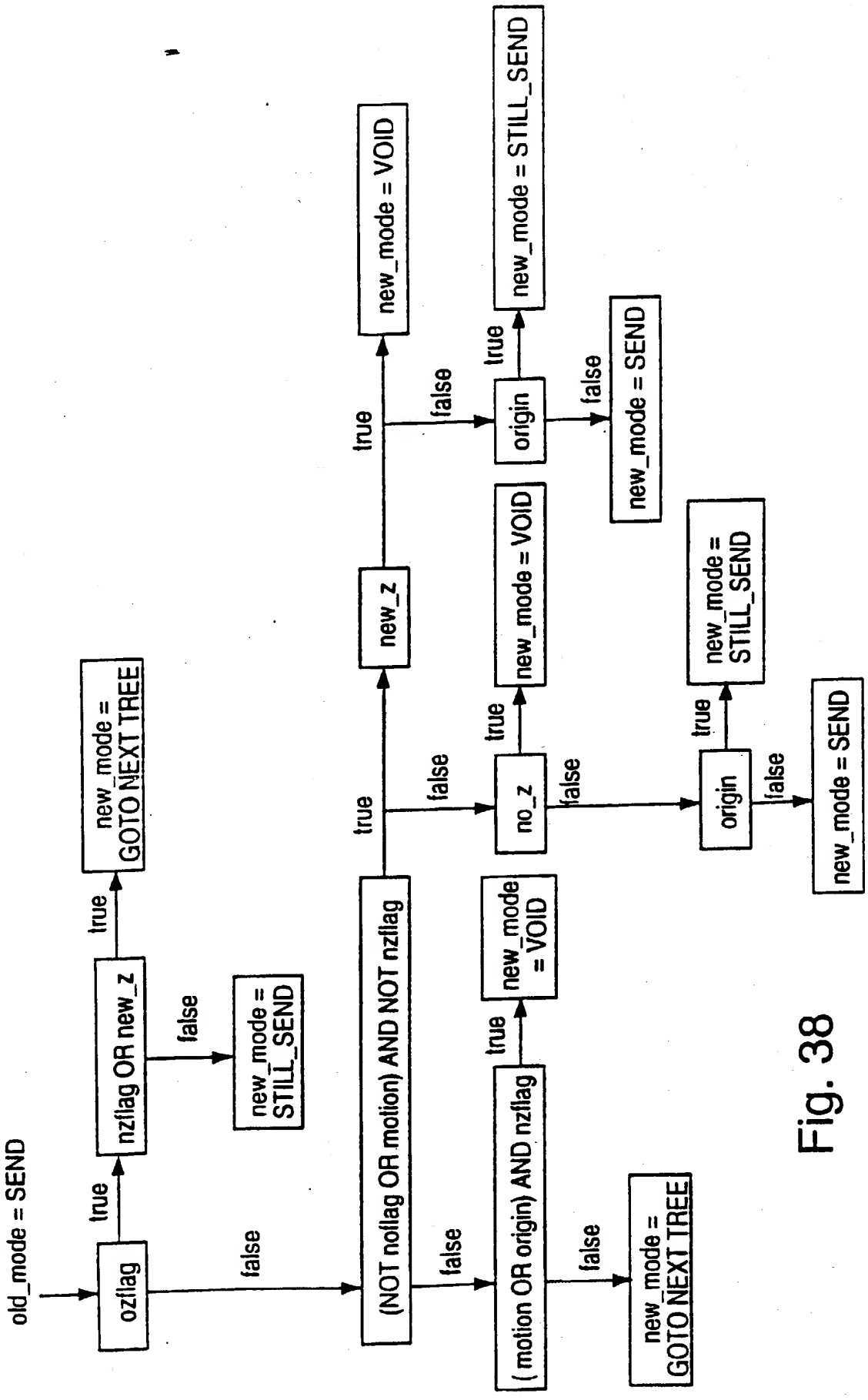

old_mode = SEND
ozflag
true
nzflag OR new_z
true
new_mode = GOTO NEXT TREE
false
new_mode = STILL_SEND
false
(NOT noflag OR motion) AND NOT nzflag
true
new_z
true
new_mode = VOID
false
origin
true
new_mode = STILL_SEND
false
new_mode = SEND
false
no_z
true
new_mode = VOID
false
origin
true
new_mode = STILL_SEND
false
new_mode = SEND
false
(motion OR origin) AND nzflag
true
new_mode = VOID
false
new_mode = GOTO NEXT TREE

Fig. 38

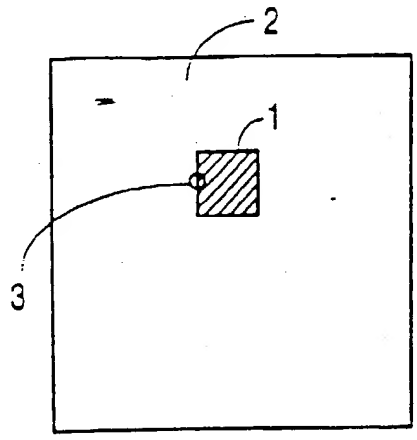


Fig. 39

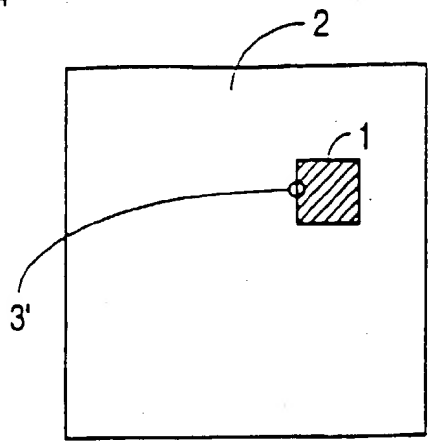


Fig. 40

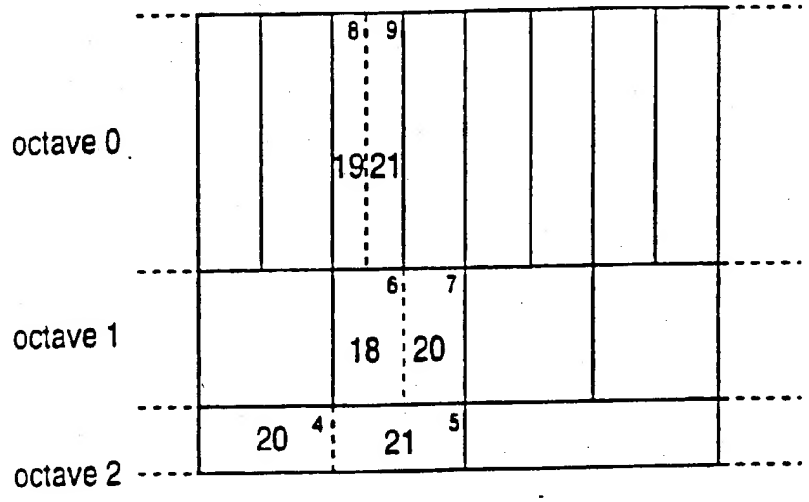


Fig. 41

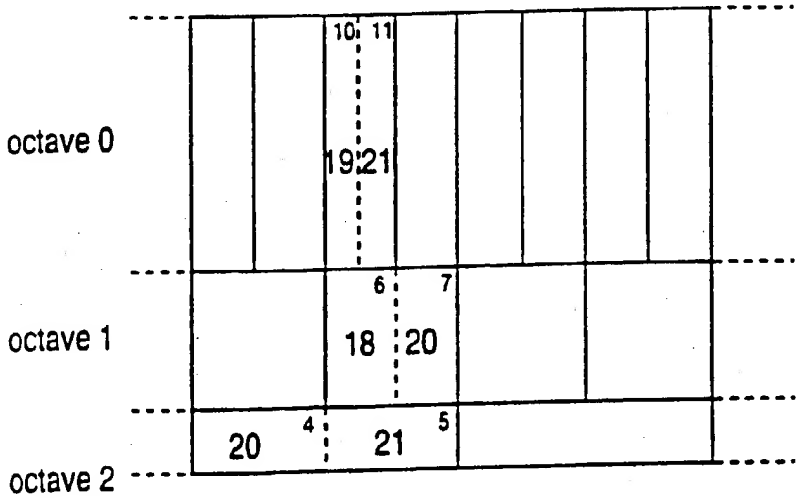


Fig. 42

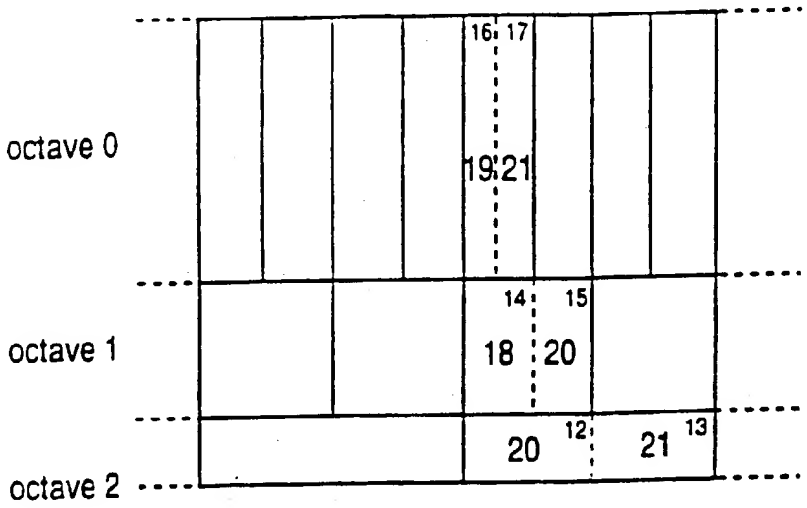
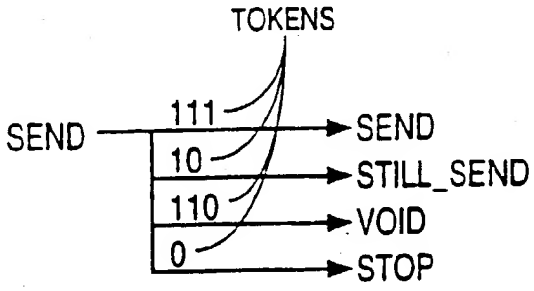


Fig. 43

VARIABLE - LENGTH TOKENS



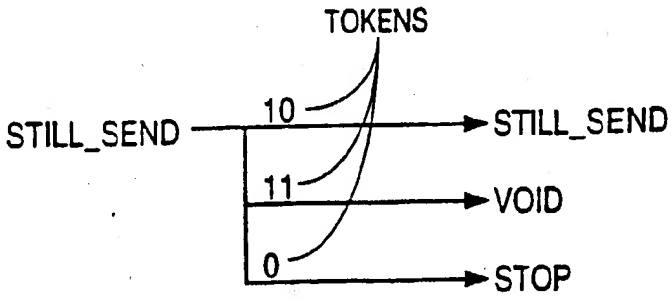


FIG. 44